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CHRISTENSEN AND BULL - ECONOMIC BASE OF SEWRB WITH EMPHASIS ON AGRICULTURAL SECTOR

THE ECONOMIC BASE OF THE SOUTHEAST WISCONSIN RIVERS BASIN WITH EMPHASIS ON THE AGRICULTURAL SECTOR

REFERENCE REPORT NO. 13

WORKING MATERIALS FOR

SOUTHEAST WISCONSIN RIVERS BASIN

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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THE ECONOMIC BASE OF THE SOUTHEAST WISCONSIN RIVERS BASIN, WITH EMPHASIS ON THE AGRICULTURAL SECTOR

by

Lee A. Christensen and Leonard L. Bull

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SUMMARY

The purpose of this report is to provide economic intelligence to planners working for the orderly development of the land and water resources of the Southeast Wisconsin Rivers Basin. While the focus is on the agricultural sector, characteristics of other sectors are presented.

Salient historical data are provided. Benchmark projections of agricultural production, employment and income are presented for 1980, 2000 and 2020, based on an analysis using a linear programming technique. These projections are predicated on an organization of resources which minimizes the cost of producing a given level of requirements.

Between 1950 and 1970, total Basin population increased 37 percent, indicating its steady growth over the past decades. This population is projected to increase 32 percent between 1960 and 1980, 38 percent between 1980 and 2000 and 39 percent from 2000 to 2020. However, within these increases, Subarea One is projected to decrease in total population. Total rural farm population is expected to decrease 32 percent between 1960 and 1980 and 46 percent between 1980 and 2020.

Total employment increased 13 percent from 1950 to 1960 while employment in agriculture decreased nearly 33 percent. Based upon a full-time worker concept, agricultural employment is projected to decrease 43 percent between 1980 and 2020.

The average household income level between 1960 and 1968 increased from $7,789 to $10,581 (35.8 percent). Major industry and service segments contributing to income are manufacturing, wholesale and retail trade, service

groups, and government. In 1966, agricultural earnings were only five percent of total Basin earnings. Net income from agricultural production is estimated to more than double between 1960 and 2020.

Land use data indicate that urban areas are rapidly expanding onto cropland, pasture and forest land. Between 1967 and 2020, a 38.3 percent increase is projected in urban areas. Changes in other land use categories for the same period include a 5.8 percent decrease in cropland, a 5.5 percent decrease in pasture and a 1.4 percent decrease in forest.

Row crop, specialty crop and most small grain production is estimated to increase over the projection periods. Hay and pasture production is expected to decline. Increased idle cropland and idle pasture indicate that increased production demands can be satisfied from the decreasing agricultural land base.

Basin production of livestock and livestock products is estimated to nearly double between 1967-68 and 2020. The only livestock product projected to decrease is chicken meat from the salvage of laying flocks. Although egg production is expected to increase, the increased egg production per bird and the projected decrease in salvage weight per bird acts to decrease the pounds marketed.

The value of agricultural production is projected to increase 55.5 percent between 1980 and 2020. The subarea-increases range from 38 percent in Subareas One and Four to 80 percent in Subarea Two.

Total rural water requirements are projected to reach 60,531 million gallons by 2020 or 166 million gallons per day. This is about 40 percent greater than the expected 118 million gallons per day in 1980.

THE ECONOMIC BASE OF THE SOUTHEAST WISCONSIN RIVERS BASIN, WITH EMPHASIS ON THE AGRICULTURAL SECTOR

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Lee A. Christensen and Leonard L. Bull[1/]

INTRODUCTION

Purpose and Scope

The purpose of this report is to provide economic information and analysis for use in planning the orderly development of the land and water resources of the Southeast Wisconsin Rivers Basin. Although the focus is on the agricultural economy, data on other sectors of the economy are included. The report presents historic conditions and benchmark projections of the agricultural economy. As such, it sets forth directions toward which the agricultural economy is expected to move, provided no additional water resource development occurs on the existing resource base. Procedures used are briefly described, as well as the assumptions on which conclusions are based.

Most of the historical data describing the agricultural economy of the basin is provided in Technical Report No. 1., A Description of the Southeast Wisconsin Rivers Basin. Highlights from this report, as well as updating based on the 1969 Agricultural Census have been incorporated. However, this report focuses on the projected rather than the past agricultural and related economy.

Projections of the rural farm population, employment, income, rural farm water needs and agricultural land use to 1980, 2000, and 2020 are presented. These projections are benchmark in nature and serve as a basis for comparison with those derived from alternative development assumptions. Projections are based on results of a linear programming model which incorporates assumptions about production requirements, available land resources, crop

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yields, non-agricultural land needs, and costs of production.

The model was formulated to yield a land use pattern for 23 soil resource groups (SRG) in the five planning subareas given a set of food and fiber demands for 1980, 2000, and 2020. The SRG's were further sub-divided with respect to flooding and drainage conditions. See Appendix I for more details on these SRG's.

The projected land use pattern was weighted according to the relative amounts of the various quality soils, the costs of production and the historical production pattern of each subarea. The pattern was constrained to reflect the retarding effect that historical or traditional production patterns and capital commitments have on shifts toward greater economic efficiency. A more realistic pattern of projected land use was obtained by applying these constraints.

The projections were based on the assumptions that there will be no major wars or catastrophies, and a favorable general economic environment will sustain demand for farm products. Population projections were used which project the total population in 2020 to be about two and one-half times the 1960 level.

The following sections present and analyze the projections which will serve as a benchmark for further analyses during the plan formulation process. In drawing implications for water resource and land use planning from the projections, one must keep in mind the nature of the data, the assumptions on which they are based and the limitations of their usefulness. First, the Conservation Needs Inventory (CNI) acreages are a critical input to the entire study since they form the basic estimate of the resources available and developable to meet future needs. The CNI is an inventory of land and water resources by land use type that was conducted by the Soil Conservation

Service in 1958 and updated in 1966-67. These data are expansions of sample data collected in 1966 but are thought to be an adequate representation of reality when used as aggregates of several counties. Estimates of yields for lands under different stages of development are also critical and significantly influence the result. Further, the costs generated for production in each subarea are critical since the linear programming model reacts to very small cost differences. These can cause crop production to shift among subareas in meeting the Southeast Wisconsin Rivers Basin agricultural requirements at minimum cost. Future cropping patterns among subareas cannot be predicted. However, given the cost differences assumed to exist among subareas and the benchmark requirements for production by subarea, this report provides a projected pattern of cropland use that would meet the production requirements at least cost. Given the assumptions, it is possible to identify which soils are most profitable to drain, based on economic efficiency, in order to minimize the overall costs of meeting the basin demands. Also identifiable are those subareas and those soils where flood protection measures would be most beneficial in reducing the on-farm cost of agricultural production given the assumptions of the projection procedure.

The following sections will present the land base available for agriculture and the results of the linear programming model under the planning objective of national economic efficiency.

Methods and Assumptions

Subarea Delineation The Southeast Wisconsin Rivers Basin lies in eastern and southern Wisconsin, north central Illinois, and northern Michigan. There are portions of two major continental drainage basins in the study area, the Upper Mississippi and the Great Lakes - St. Lawrence. The total drainage

area is about 15,530,600 acres, or 24,266 square miles.

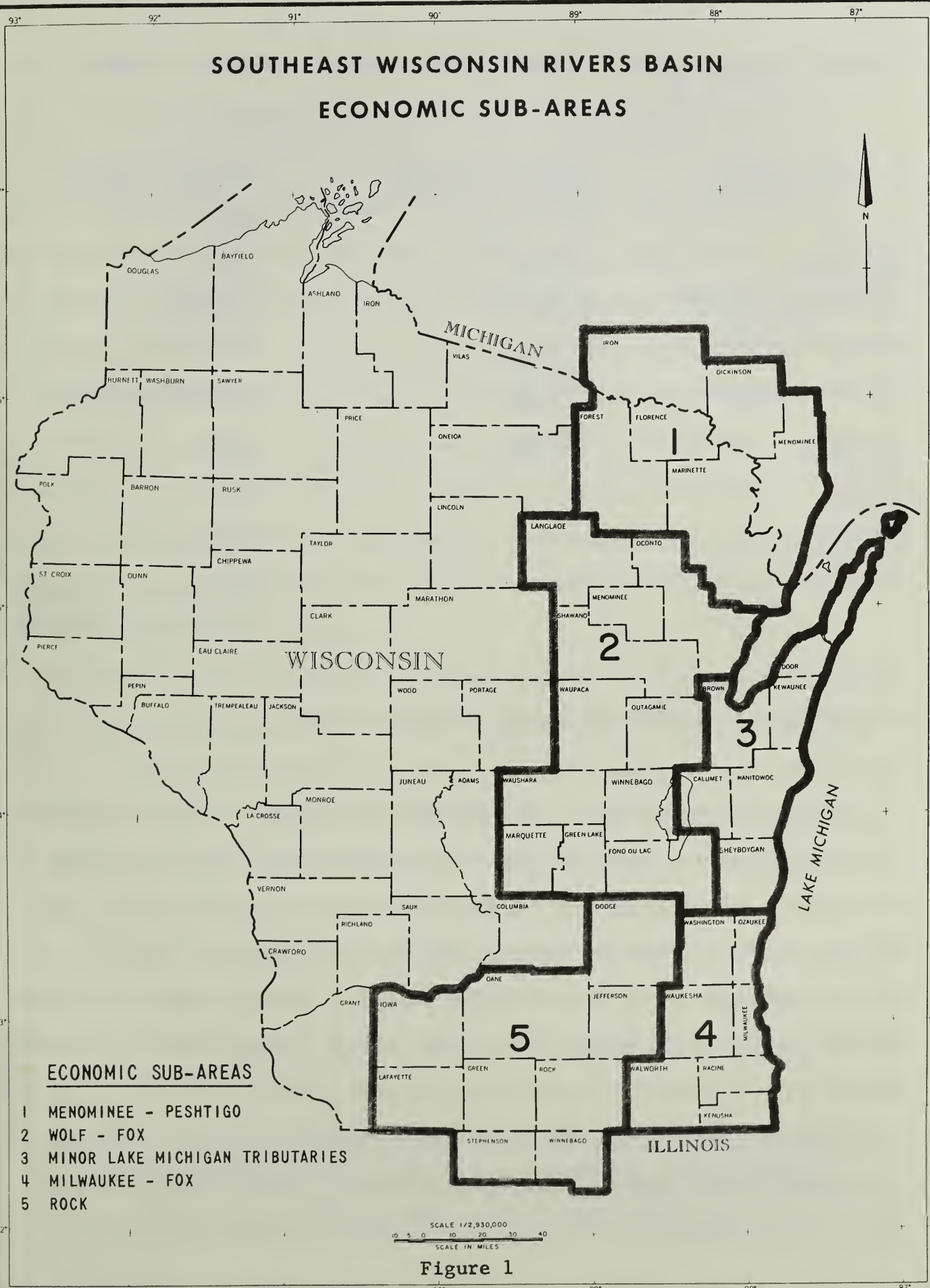
The study area is bounded on the east by Lake Michigan, on the west by the Wisconsin and Galena-Platte drainage basins, on the south by the Wisconsin state line, except for the inclusion of the Rock River basin, downstream to Rockton, Illinois, and on the north by the northern boundary of the Menominee River basin in Michigan (Figure 1). The Rock and Fox River drainage areas flow south and west to join the Mississippi River while the other drainage areas flow to the Great Lakes.

For economic analysis, five subareas within the Southeast Wisconsin Rivers Basin have been delineated (Table 1, Figure 1). The subarea boundaries were selected as a compromise so as to (a) encompass an area that is relatively homogeneous with respect to problems, (b) include an area of a minimum of five or six counties, (c) approximate hydrologic river basin boundaries as closely as possible, (d) be consistent with other development studies in the area, and (e) encompass entire metropolitan market areas. The entire Basin includes thirty-four counties in Wisconsin, three in Michigan, and two in Illinois.

A degree of comparability exists between the Southeast Wisconsin Rivers Basin and Great Lakes Basin Type I subareas. SEWRB Subareas One, Two and Three correspond directly to Great Lakes Planning Subarea 2.1. SEWRB Subarea Four covers the Wisconsin portion of Great Lakes Planning Subarea 2.2. SEWRB Subarea Five is outside the Great Lakes Basin and is a portion of the Rock Sub-basin of the Upper Mississippi Basin.

SOUTHEAST WISCONSIN RIVERS BASIN

ECONOMIC SUB-AREAS



ECONOMIC SUB-AREAS

1 MENOMINEE - PESHTIGO
2 WOLF - FOX
3 MINOR LAKE MICHIGAN TRIBUTARIES
4 MILWAUKEE - FOX
5 ROCK

SCALE 1/2,930,000

10 5 0 10 20 30 40

SCALE IN MILES

Figure 1

Table 1. Southeast Wisconsin Rivers Basin, Economic Subareas - County Listing. 1/

Economic Subarea 1	Economic Subarea 2	Economic Subarea 3
Florence	Fond du Lac	Brown
Forest	Green Lake	Calumet
Marienette	Langlade	Door
Dickinson - Michigan	Marquette	Kewaunee
Iron - Michigan	Menominee	Manitowoc
Menominee - Michigan	Oconto	Sheboygan
	Outagamie	
Economic Subarea 4	Shawano	**Economic Subarea 5**
	Waushara	
Kenosha	Waupaca	Dane
Milwaukee	Winnebago	Dodge
Racine		Green
Ozaukee		Iowa
Walworth		Jefferson
Washington		Lafayette
Waukesha		Rock
		Stephenson - Illinois
		Winnebago - Illinois

1/ Counties are in Wisconsin unless otherwise listed.

Methodological Approach The framework for analysis is subdivided into three major phases. First, regional-share estimates were made of national requirements for food, feed, and fiber production for the years 1980, 2000, and 2020. The Southeast Wisconsin Rivers Basin's "benchmark" share of national and Great Lakes Basin requirements for various agricultural products is based on historical shares and projected trends in marketing and production. This estimate reflects the comparative advantage embodied in historical trends of this Basin relative to other regions of the country--the inter-regional competitive factors such as land productivity and production and marketing costs. These projections of national and regional agricultural production

requirements are referred to as OBERS projections.[2/] They serve as benchmark, or basic set of projections from which to make economic analyses of alternatives. They reflect coordination and organization of regional as well as interregional information and are consistent with a projected national framework. Any adjustment in one sector or region must be evaluated to determine whether or not it affects other sectors or regions. Compensating adjustments in other parts of the Nation, in exports, or in other elements of the production system may result. A change in one region suggests opportunities gained or foregone in other regions. These economic effects should be a part of the evaluation. OBERS projections for the Nation, as a whole, can be adjusted but the adjustment must be done systematically in order to determine the implications in various parts of the country and in various sectors of the economy.

A consistent set of projections must reflect the interregional relationships of activity which exist and which planners should take into consideration. A regional development plan that increases production over the baseline projection without considering off-setting interregional effects would cloak regional development under the guise of national efficiency. Should one region be permitted to do this, other regions could logically adopt this same approach. The objectivity of the nationwide framework studies and the fundamental assumption that framework studies are being developed on a common base would appear to be weakened, if not completely destroyed.

2/ OBERS projections were made jointly at the Washington level by the Office of Business Economics (OBE), U.S. Dept. of Commerce, and the Economic Research Service (ERS), U.S. Dept. of Agriculture, under an Interdepartmental Agreement dated March 6, 1964, through the Water Resources Council.

Second, an analysis was made of the capacity of the land resources to produce food and fiber. Yield estimates were made for the various crops on each soil group. The costs of obtaining those yields under average weather and management conditions were also estimated. Projections of livestock productivity, feed requirements and water needs were made. Third, the demand and supply possibilities were brought together in a computerized analytical system. It was designed to simulate the decision process of the producers who control the resources and weigh the alternative costs and returns in making production decisions. The results of the computer program provided baseline projections of major crop production in the planning subareas of the Southeast Wisconsin Rivers Basin. Alternative ways of meeting future requirements should be kept in mind when interpreting these projections. These include private practices, such as adoption of yield increasing technology, better management, and land-use changes, as well as public investments in water resource development.

Estimates of future farm employment were derived from the labor requirements associated with crop and livestock production implied by the projections. Population estimates were derived from the employment patterns through use of population-employment dependency ratios for each subarea. Farm income was determined by computing the value of agricultural output and subtracting production expenses.

The Basin requirements for food grains and for fruits and vegetables are based on population growth, per capita consumption and historical shares of production. The demand for feed grains and roughages are derived from the livestock feed needs associated with the demand for marketed livestock

products. Livestock product requirements were allocated to planning subareas on the basis of historical shares and discernible trends. Based on projected feeding efficiencies and ration composition, requirements for feed grains and roughages were estimated. Increased efficiency in livestock feed conversion, improved livestock breeding, better feed management, and improvements in protein content of feed grains are expected to reduce the feed-grain requirements per unit of livestock product. Since portions of the Basin are historical exporters of feed grains, the total feed grain requirements are in excess of amounts required for livestock production.

Although results can be aggregated in such categories as feed grains, food grains, roughage, and specialty crops, the analysis itself is performed on specific crops. Thus, the demand side of the study was translated into the production framework in terms of specific crops. These include oats, wheat, corn for grain, corn silage, alfalfa hay, clover-timothy-other hay, soybeans, cropland pasture, and permanent pastures.

Crops involving relatively minor acreages or those which were not widely distributed throughout the Basin were handled outside of the model. Included were barley, rye, sugar beets, dry field beans, potatoes, fruits, lawn sod, and vegetables. Projected acreages required for these crops were removed from the resource base available for major field crop and roughage production.

The future supply of agricultural products depends upon the production potential of the agricultural resource base of the Southeast Wisconsin Rivers Basin. The inventory of existing crop and pasture land base was that identified by the 1966-67 Conservation Needs Inventory. This inventory identified the type and acreage of specific soils and their major land use,

on a county basis. It served as the reference point for collection of land use and crop yield data used in the study. This information was collected for soil resource groups.

Soil resource groups (SRG's) are homogeneous groupings of land capability units. 3/ The land capability units were grouped by soil scientists and economists according to similarities of texture and management problems, such as wetness, flood hazard and droughtiness. They generally have similar cropping patterns, yield characteristics and response to management practices. All soils in the Basin were placed in one of 23 soil resource groups described in detail in Appendix 1. Climatic differences are not explicitly reflected in the SRG's, but are reflected in the distribution of crops and crop yield differences of the respective subareas.

Within certain soil resource groups, factors inhibiting agricultural production were identified. These include inadequate drainage, flooding, erosion problems associated with slope characteristics, soil texture, and other factors such as stoniness.

Land available for agricultural production in 1980, 2000, and 2020 will be less than in the base period by the amount required for urban and industrial expansion and for transportation and recreation needs. These requirements have been estimated, based on regression analysis utilizing projections of population, population change, and employment. The cropland and pasture base remaining after removal of urban and built-up requirements is considered available for crop production under assumed conditions of management and technology.

3/ A land capability unit is a grouping of small soil units having similar productivity under similar management practices, requiring similar conservation treatment and management, and having comparable potential productivity. It is one of the basic soil inventory units used by the Soil Conservation Service.

For each soil resource group available for crop production, average yields were estimated for alternative crops along with the fertilizer requirements associated with each crop. The projected yields were based on anticipated technological changes and represent average management levels assuming normal climatic, disease, insect and other hazard conditions. The costs of production for each crop for individual planning subarea groups were also estimated. These costs include preharvest and harvest costs, and where appropriate, the specific cost which would be incurred in cultivating relatively steep slopes. They also reflect costs associated with or incurred because of lack of drainage and flood protection.

A farmer must select from various alternatives the crops he will raise, given his resource base, his managerial ability and relative costs and receipts. A basic assumption of this analysis is that he seeks to maximize his returns and that over the long run, he tends to choose that set of crops which will be most efficient in the use of available resources. In the long run, the various alternatives have their opportunities to be considered and tested by the farmers in a trial and error method. But this analysis does not have the "long run" in which to make projections. The substitute is a generalized analytical model designed to simulate the process of choosing from among the various alternatives. The mathematical process used is minimum cost linear programming, a more exact form of enterprise budgeting. Within the system, resources and associated costs and yields are brought together, compared, and the least costly set, in terms of resource uses, is identified and selected as representing the aggregate results of farmers' decision processes over time. All of this is accomplished within certain constraints designed to promote "realism" in the analysis. Such constraints consist of

requiring crop rotations, especially on steeper soils and limiting the magnitude of shifts into and out of agriculture within subareas. This is to recognize the relatively fixed nature of large capital investments in agriculture in particular areas and other social or institutional barriers to change.

The generalized analytical model analyzes and projects agricultural production patterns by soil resource groups within planning subareas of the Southeast Wisconsin Rivers Basin. These benchmark production patterns are based on the comparative advantage of the Basin's soil and water resources without additional resource development.

The minimum cost linear programming model, as used here, is a tool for simulating decisions with respect to land use when certain levels of demand for food and fiber are assumed. In the operation of the model, the cropping pattern is selected, among cropping alternatives possible, that will minimize the cost of achieving this level of production within the restraints likely to confront agriculture. All analysis is done on the basis of planning subareas and the associated soil resource groups.

The principal purpose of this model is to estimate patterns of agricultural land use from projected levels of future production. The basic assumption of the analysis is that all future production patterns will be related to and restricted to a degree by the current pattern of use. 4/

4/ The current patterns of use were developed using a normalizing process. Current normal is a concept used to describe estimates which conform with or constitute an acceptable model or pattern. In this study, acreage, production, price and value of crop production, and production, price, and value of livestock production have been adjusted to conform to a consistent pattern. Current normal values of the above parameters are estimates which reflect current production technology and prices, from which the impacts of abnormalities caused by weather and other hazards in a single year were weighted by their historical occurrence. Normalization may also be described as a geometrically weighted moving average. The process, as used in this report, was based on historical data for the years 1939 to 1968.

These changes will result in shifts toward more efficient use of the resources within recognizable limits imposed by crop rotations, diversification, institutional restrictions, complementarity of crop enterprises, and complementarity of roughage production, pasture land, and livestock enterprises.

General Assumptions and Limitations The benchmark projections of agricultural activity in the Southeast Wisconsin Rivers Basin are based on the assumption of a growing and increasingly prosperous population which will demand more and more goods and services. Projected demands for agricultural products reflect estimates of consumer preferences, labor and other resource efficiencies, and rates of technological developments in both mechanical-physical areas and in the bio-chemical fields. Pressures on resources may well induce new, unexpected changes in technology and in plant and animal breeding. However, projections assembled in this appendix represent an informed judgment of the future, based upon current information.

The general assumptions made for this study are outlined below:

1. Assumptions that affect demand for food and fiber:
    a. The national population will increase approximately 30 percent during each 20-year period from 1960 through 2020. At this rate, population will more than double between 1960 and 2020. The population estimates are: 1960, 180 million; 1980, 234.2 million; 2000, 306.8 million, and 2020, 397.6 million.
    b. National personal income will increase over tenfold between 1960 and 2020, from $399 billion to $4,934 billion.
    c. Increased per capita food consumption will result from rising personal incomes through 1980. Beyond 1980, further

increases in personal incomes will have an insignificant influence on per capita consumption

d. A general shift in consumption patterns will occur over time. For example, people are expected to consume more beef and poultry relative to dairy products and eggs.

e. Both import and export volume of agricultural commodities is expected to increase over the 1959-61 level. Increases are projected for imports of beef, pork, milk products, vegetables, noncitrus fruits and tree nuts. Exports of livestock and livestock products, corn, wheat, rice, soybeans, vegetables and fruits are projected to increase. Greatest export increases are expected for milk products, corn, grain sorghum, wheat, and soybeans. On balance, the foreign market demand for United States' agricultural products is projected to increase considerably above the 1959-61 average level. Trends were projected to 1980 and held constant for 2000 and 2020. Thus, exports as a share of total production will be less in 2000 and 2020 than in 1980.

2. Assumptions that affect the supply of food and fiber:

a. The basic inventory of agricultural land is that identified by the 1966-67 National Inventory of Soil and Water Conservation Needs with appropriate adjustments for projected land withdrawals for urban and other uses.

b. Projected crop yields and costs reflect estimates of future technology based on increased adoption of presently known techniques as well as implementation of new developments.

c. Fixed livestock feed efficiencies were assumed for each time period and each class of livestock uniformly throughout the Basin. The crop composition of feed ration categories of feed grains and roughages was allowed to vary within subareas to reflect comparative advantage.

d. Farmers will continue to implement practices which prevent significant losses of production capability from erosion, depletion, infertile outwash, and other factors causing deterioration of soils and reduced yields over the projection period.

e. Over the long run, it is assumed that farmers organize their resources to minimize production costs and thereby take advantage of the Basin's comparative advantage for agricultural production. However, it was assumed that such changes would be gradual. Constraints were imposed to prevent abrupt and unrealistic shifts in production patterns between subareas.

f. The institutional framework of the Basin and the Nation are assumed to remain relatively constant over time.

3. Other general assumptions:

a. That general economic stability will prevail during the projection period; that no major war or economic recession will occur; and that a high level of economic activity and nearly full employment will be maintained. This does not rule out periodic cyclical adjustments in economic activity.

b. That prices used for agricultural products are based on the adjusted normalized prices published by the Water Resources Council. 5/ Cost data is based on 1969-1971 relationships.

c. That current normal relationships among inputs and between inputs and outputs will continue through the projection period and that inputs of type and quantity needed will be available.

d. That government agricultural programs will continue during the projection period; but that the price system and profit incentives will be the dominant factor in allocation of resources. This implies a gradual decrease in production restraints and greater market influence during the projection period.

e. That private and public supported programs in research and extension will continue at present levels.

f. That marketing and transportation facilities will be adequate to handle the projected agricultural production.

g. That credit availability, tenure arrangements, zoning and taxation policies will not interfere with agricultural adjustments, including farm consolidation or purchases of new technologies.

5/ Source: Interim Price Standards for Planning and Evaluating Water and Land Resources, Interdepartmental Staff Committee of the Water Resources Council, Washington, D.C. April 1966

4. Assumptions embodied in determination of national and regional requirements:

The benchmark projections of the future rely heavily on historical trends and relationships. Extension of these trends and relationships, modified by factors known to be operating in a direction to change these relationships, appears to be the most logical for long-term benchmark projections.

Increased domestic requirements for the major farm commodities considered in this report are a function of population growth and projected per capita consumption. The estimates of domestic consumption requirements are derived from the population estimates for each time period and the assumed per capita consumption rates. These rates for the years 2000 and 2020 have been held at the rate projected for 1980. Consumption requirements for the later time periods become a direct function of population.

Population projections for 1980 and 2000 were the Series C estimates made by the Bureau of the Census. One of four alternative projections, Series C, assumes a medium-low fertility rate and an annual growth in population of approximately 1.3 percent. This is considerably lower than the 1.7 percent rate prevailing in the 1945-65 period. These population estimates are for the 50 United States.

Projected Per Capita Use

The per capita consumption of various agricultural products has been changing with rising incomes, shifting tastes, substitute products, and lower relative prices.

The 1980 per capita consumption of meat is projected to increase from 1959-61 levels. Per capita consumption of eggs, dairy products, and cereal grains is expected to decline by 1980. On the other hand, the consumption of oil seeds is expected to increase. Tobacco consumption is projected to remain constant. Industrial uses of major farm commodities were maintained at a constant per capita level for all time periods.

Imports and Exports

The expansion of world markets has resulted in a large increase in United States agricultural exports. Public Law 480, and other export assistance programs, have been the primary forces behind the increase in United States foreign marketings. A large upsurge occurred during the early 1960's, but subsequently slackened. The production of export commodities required about 64 million acres of land in 1960, peaked at 77 million acres in 1963, but declined to 58 million acres in 1969. 6/ Productivity increases allowed the export demand to be met on this decreased acreage. Important commodities include soybeans, soybean meal, feed grains, poultry and poultry products.

The importance of the world market for U.S. agricultural products is assumed to continue. Both import and export volume are expected to increase over the 1959-61 level but with some decrease in particular commodities. Substantial increases are projected for imports of beef, vegetables, non-citrus fruits, and tree nuts. Relative decreases are projected for imports of lamb and mutton, barley, rye, oats, rice and sugar. Exports of livestock and livestock products, corn, wheat, rice, soybeans, vegetables, fruit, cotton, and tobacco are projected to increase by 1980.

6/ Changes in Farm Production and Efficiency, A summary Report, 1970 Statistical Bulletin 233, USDA, July 1970.

The national requirements for major food and fiber crops were estimated as the sum of domestic consumption, other domestic uses, and export requirements. Domestic consumption was calculated as the product of the population estimates times the estimated per capita consumption levels. The projected expansion of total population created a continued increase in domestic requirements for all commodities. This increase will be required even with important consumer taste-shifts among food groups.

Livestock and Meat Product Requirements

The national requirements for major livestock and meat products were estimated as the sum of domestic food consumption, other domestic use and export requirements. Domestic consumption was calculated by multiplying the population estimates by the per capita consumption estimates. Except for a slight decrease in lamb consumption by 1980, population increases will require ever higher levels of livestock production. Export demand, likewise, will increase for all animal products, except eggs. Other uses of livestock products (such as hatching eggs and milk for calves) will increase in proportion to the final products.

Benchmark Production Requirements

Projected benchmark requirements for food and fiber production in the Southeast Wisconsin Rivers Basin are provided in Tables 2 and 3, along with their relationship to Great Lakes Basin and national requirements. These requirements are not estimates of production to make the basin self-sufficient. Rather, they incorporate the historical production and trade patterns of the region into the national framework. A portion of the requirements are direct suballocations from the Great Lakes Basin share

Table 2. **Crop Requirements:** United States, Great Lakes Basin, and Southeast Wisconsin Rivers Basin; 1959-61 **Estimated Average Production and Projected Requirements, 1980, 2000, and 2020; With Indexes of Change.**

Commodity and Area	Unit	Estimated 1959-61 Average [1]	Requirements			Index of Change		
			1980	2000	2020	1980	2000	2020
			(Thousand Units)			(1959-61 = 100) [1]		
Corn:	Bu.							
United States		3,786,070	5,053,570	6,371,426	7,942,856	133	168	210
Great Lakes Basin		298,857	383,357	506,679	675,071	128	170	225
S.E. Wisconsin Rivers Basin		93,956	122,572	164,131	222,030	130	175	236
Oats:	Bu.							
United States		1,072,937	1,112,500	987,500	687,500	104	92	64
Great Lakes Basin		142,000	154,375	143,500	105,813	109	101	75
S.E. Wisconsin Rivers Basin		71,908	82,381	72,072	70,266	114	100	98
Barley:	Bu.							
United States		416,458	512,500	508,333	458,333	123	122	110
Great Lakes Basin		5,917	5,917	6,042	5,625	100	102	95
S.E. Wisconsin Rivers Basin		1,329	1,817	1,914	2,042	137	144	153
Wheat:	Bu.							
United States		1,237,700	1,873,600	2,127,500	2,458,600	151	172	199
Great Lakes Basin		74,400	96,400	111,800	133,600	130	150	180
S.E. Wisconsin Rivers Basin		1,581	2,301	2,423	2,870	145	153	182
Rye:	Bu.							
United States		27,868	41,400	54,100	71,800	148	194	258
Great Lakes Basin		1,945	1,902	2,516	3,386	98	129	174
S.E. Wisconsin Rivers Basin		243	588	600	596	242	247	245
Soybeans:	Bu.							
United States		589,257	1,268,900	1,531,900	1,860,900	215	260	316
Great Lakes Basin		50,045	107,440	135,048	174,176	215	270	348
S.E. Wisconsin Rivers Basin		1,001	4,087	4,721	5,989	408	472	598

Table 2. (Continued - crop requirements)

Commodity and Area	Unit	Estimated 1959-61 Average 1/	Requirements 1980	Requirements 2000	Requirements 2020	Index of Change 1980	Index of Change 2000	Index of Change 2020
			(Thousand Units)			(1959-61 = 100) 1/		
Potatoes:	Cwt.							
United States		265,609	319,100	420,600	551,200	120	158	208
Great Lakes Basin		20,225	21,180	28,988	40,404	105	143	200
S.E. Wisconsin Rivers Basin		4,625	5,525	7,651	10,758	119	165	232
Noncitrus Fruit:	Tons							
United States		9,952	12,600	17,200	22,900	127	173	230
Great Lakes Basin		1,105	1,457	2,097	2,996	132	190	271
S.E. Wisconsin Rivers Basin		58	68	99	138	117	171	238
Vegetables:	Cwt.							
United States		403,902	615,900	801,800	1,034,600	152	198	256
Great Lakes Basin		46,093	72,380	99,295	137,171	157	215	298
S.E. Wisconsin Rivers Basin		16,222	33,963	48,782	66,589	209	300	410
Alfalfa Hay:	Tons							
Great Lakes Basin		8,991	9,763	10,084	10,982	108	112	122
S.E. Wisconsin Rivers Basin		4,435	5,093	4,989	4,630	115	112	104
All Other Hay:	Tons							
Great Lakes Basin		3,070	3,385	3,099	3,018	110	100	98
S.E. Wisconsin Rivers Basin		638	593	561	543	93	88	85
Corn Silage:	Tons							
Great Lakes Basin		14,962	16,374	21,904	28,912	109	146	193
S.E. Wisconsin Rivers Basin		6,036	7,991	10,079	13,387	132	167	222

1/ For SEWRB, the base period is 1959.

Table 3. Livestock and Livestock Product Requirements: United States, Great Lakes Basin, and Southeast Wisconsin Rivers Basin; 1959-61 Estimated Average Production and Projected Requirements, 1980, 2000, and 2020; With Indexes of Change.

Product and Area	Estimated 1959-61 Average	Requirements			Index of Change		
		1980	2000	2020	1980	2000	2020
	(Million Pounds)				(1959-61 = 100)		
Beef and Veal: 2/							
United States	28,899	47,506	60,588	79,506	164	210	275
Great Lakes Basin	1,393	2,169	2,974	4,135	156	213	297
S.E. Wisconsin Rivers Basin	523	774	993	1,259	148	190	241
Lamb and Mutton: 2/							
United States	1,683	1,630	2,160	2,831	97	128	168
Great Lakes Basin	55	53	74	104	96	134	189
S.E. Wisconsin Rivers Basin	10	6	7	8	60	70	80
Pork: 2/							
United States	20,220	25,947	33,990	44,056	128	168	218
Great Lakes Basin	932	1,277	1,763	2,446	137	189	262
S.E. Wisconsin Rivers Basin	537	607	789	1,021	113	147	190
Farm Chickens: 2/							
United States	1,252	1,396	1,824	2,362	115	146	189
Great Lakes Basin	83	86	118	163	103	142	196
S.E. Wisconsin Rivers Basin	13	8	7	7	62	54	54
Broilers 2/							
United States	6,207	10,263	13,293	17,094	165	214	275
Great Lakes Basin	93	88	117	161	95	126	173
S.E. Wisconsin Rivers Basin	14	5	7	9	36	50	64
Turkeys: 2/							
United States	1,601	3,419	4,448	5,746	214	278	359
Great Lakes Basin	77	155	213	294	201	277	382
S.E. Wisconsin Rivers Basin	7	10	14	19	143	200	271

Table 3. (Continued - livestock and livestock product requirements)

Table 3. (Continued - livestock and livestock product requirements)

Product and Area	Estimated 1959-61 Average	Requirements 1980	Requirements 2000	Requirements 2020	Index of Change 1980	Index of Change 2000	Index of Change 2020
	(Million Pounds)				(1959-61 = 100)		
Milk:							
United States	123,461	139,372	181,490	234,266	113	147	190
Great Lakes Basin	20,365	23,343	31,974	44,130	115	157	217
S.E. Wisconsin Rivers Basin	9,225	10,009	12,168	15,485	108	132	168
Eggs: 3/							
United States	62,302	72,613	95,251	123,886	117	153	199
Great Lakes Basin	4,695	4,766	6,556	9,105	102	140	194
S.E. Wisconsin Rivers Basin	686	700	851	1,043	102	124	152

1/ Projected requirements are preliminary.

2/ Liveweight basis.

3/ Requirements expressed as million eggs.

of national requirements. Projections for Subarea Five were included, based on projections for the Upper Mississippi area study. By coordinating projections within and among regions, benchmarks are developed for each region which insures a degree of consistency between regional and national projections. Basin crop production requirements generally increase for all crops through 2020.

The SEWRB share of national requirements is projected to increase for corn, barley, soybeans, potatoes, fruits, and vegetables. Oats are an exception; a reflection of a declining national requirements. Requirements for alfalfa hay decline slightly due to an assumed substitution of silage in livestock rations.

Increases in production are projected for all types of livestock products except chickens. Dairy and beef feeding operations will continue as important segments of the livestock economy.

Definition of Terms

The following definitions are provided to clarify terminology presented in the text.

1. Linear Programming--a major tool of the empirical method known as activity analysis. As used in this study, it refers to the computational method used to prescribe the production patterns which minimize the cost of producing projected requirements of food and feed. The objective function, i.e., the total cost of producing requirements, is minimized subject to resource and institutional constraints, expressed in linear form. Linear programming is a method for providing normative answers to

problems. That is, answers which indicate the course of action which ought to be taken by the individual, business unit, or region to achieve a stated objective.

Requirement--quantity of a commodity or service (expressed in appropriate units) under stated assumptions of location and time and at a specific price. Requirements for specific commodities are translated into needs for water and land as a basis for plan formulation.

2. Demands--quantities of a commodity or service (expressed in appropriate units) desired under stated assumptions of location and time and a range of prices. Demands for specific commodities are translated into demands for water and related land as a basis for plan formulation.
3. Supply--quantities of a commodity or service (expressed in appropriate units) available under stated assumptions of location and time and range of price. The supply of water and related land represents the basic resource of concern. The development of this resource is related in plan formulation to the supplies of commodities and services required to meet requirements.
4. Need--the requirement for water and related land development to meet the deficit in commodities or services identified in the study at a specific time, location, and price, as determined by the analysis of requirement and supply.

CHARACTERISTICS OF THE BASIN

Physical Characteristics

Data on geology and land form regions, climate, and soils information are summarized below. This and additional information is contained in Technical Report No. 1, A Description of the Agricultural Economy of the Southeast Wisconsin Rivers Basin.

Geology and Land Form Regions The western one-half of Subarea Five is in the "Driftless Area", an unglaciated region. The rugged landscape has numerous rock outcrops, a relief of several hundred feet, and a dendritic drainage pattern. The remainder of this subarea is within the land form region designated as the Eastern Ridges and Lowlands. This area has been glaciated and mantled with thick and thin glacial outwash, moraine, lake, deltaic, and miscellaneous drift deposits. The land is generally undulating but broken by the pronounced cuestas and glacial moraines. There are a few natural lakes larger than 3,000 acres. This land form covers much of the entire study area. Its western boundary extends northeasterly in Wisconsin from northern Dane County to southeastern Marinette County.

Waushara, Marquette, and parts of neighboring counties are within the Central Plain Land form. Underlain mainly with sandstone, local relief is variable, but nowhere is it very great. The northern portion of the Basin is located in the Northern Highland. The greater portion of this region consists of a level to gently rolling surface of relatively high elevation but in most places having low relief. Three types of hills can occur, (1) sandstone outliers, (2) monadnocks, and (3) terminal and

recessional moraines. There are many lakes and swamps.

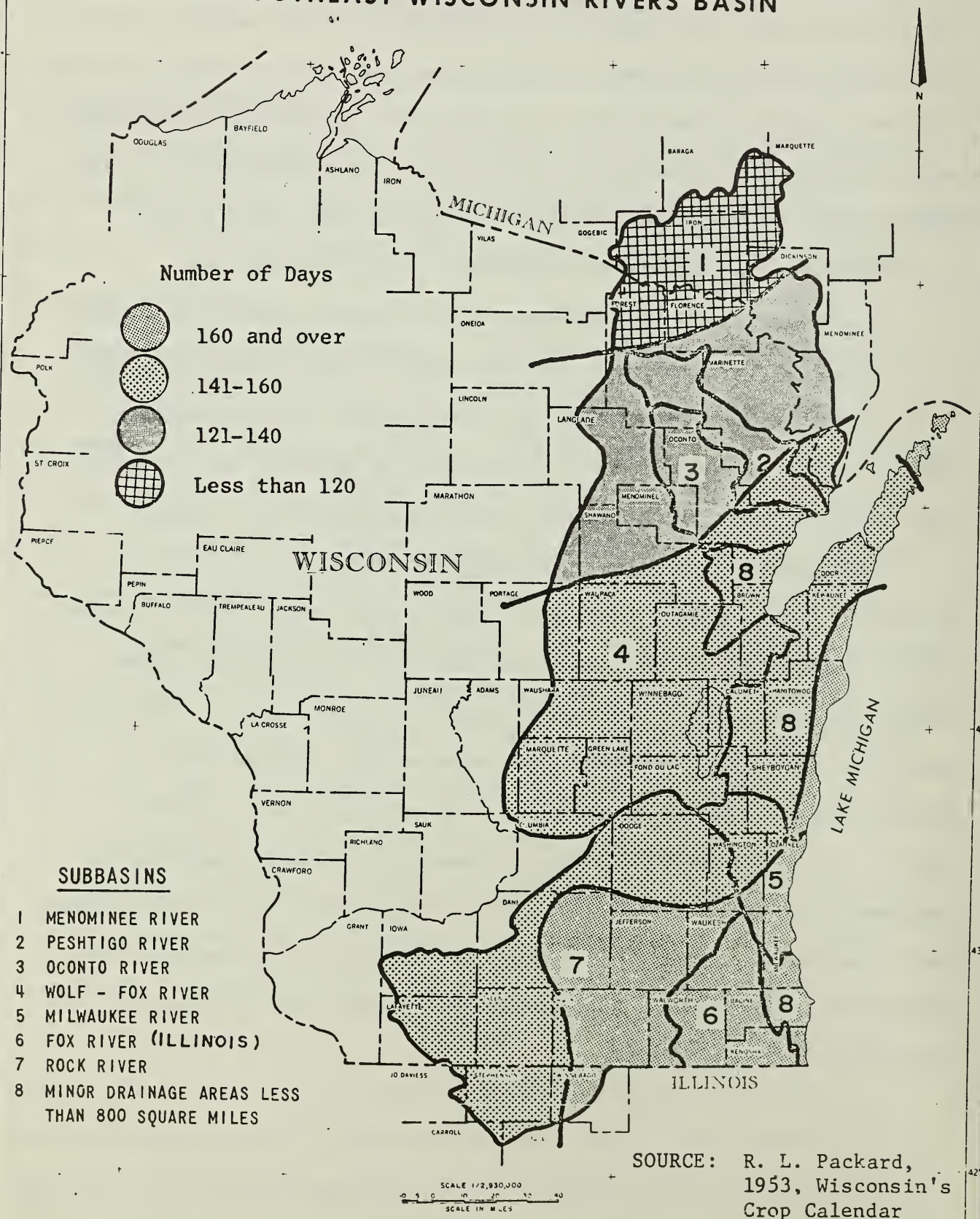
Climate. The average annual temperature is about 42° Fahrenheit in the northern part of the Basin and 48° Fahrenheit in the southern portion. The climate is characterized by marked temperature changes during the year. For short durations temperatures may exceed 100° Fahrenheit in the summer and fall below -30° Fahrenheit in the winter. The growing season is less than 90 days in the extreme north and 170 days in some parts of the southern areas and along the Lake Michigan shoreline (Figure 2).

The average annual precipitation varies from 29 inches in the north to 33 inches in the southern part of the Basin. Approximately two-thirds of the precipitation comes during the summer months (May-September). Average annual snowfall in the southern areas is slightly over 30 inches and around 70 inches in the extreme northwestern area of the Basin.

General Soils Description. Economic Subareas Four and Five primarily contain greyish brown silt loams (Miami, Dodge, McHenry, Morley, Blount, Casco, Rodman) with some black silt loams (Wea, Warsaw, Varna, Elliot, Waupun, Mendota) and a small amount of organic soils. The greyish brown silt loams have developed from loess and limy glacial tills of loamy texture. With the exception of some wet lands and the gravelly hills of the Kettle Moraine, they are generally suited for agricultural purposes. Interspersed among the greyish brown silt loams are some organic soils that are used for truck cropping and some wet soils that are prime wetland wildlife habitats. The black prairie soils are slightly acid but usually have excellent tilth.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GROWING SEASON
AVERAGE NUMBER OF DAYS
SOUTHEAST WISCONSIN RIVERS BASIN



SOURCE: R. L. Packard, 1953, Wisconsin's Crop Calendar

USDA-SCS-LINCOLN, NEBR. 1969
S,L-27243

FIGURE 2

In addition to the greyish brown silt loams described above, many of the soils in Subarea Three are reddish clay loams (Kewaunee and Manawa). These soils are usually productive but require careful management. In general, the soils east of the Upper Wolf River in Subarea Two are similar to the soils of Subarea Three. The soils west of the river are generally less fertile and consist mainly of sandy loams (Onaway, Emmet, and Shawano). Many of these soils are better suited to utilization as forest land. Waushara and Marquette counties have light colored sandy soils (Plainfield and Oshtemo), which are quite droughty, but an abundance of ground water allows substantial irrigation which makes these soils highly productive for vegetable and specialty crops.

Subarea One has stony sandy loams (Iron River) and reddish brown sands (Omega and Vilas). The terrain is generally undulating where they occur and drainage is considered to be good. These soils are droughty, acid, low in fertility, and subject to both wind and water erosion. These characteristics plus the short growing season limit their usefulness for farming, but a majority will support forest growth and provide opportunities for the development of forest resources. Some sands along Green Bay contain enough organic material to grow specialty crops.

For purposes of analysis, the Basin soils were evaluated in terms of Soil Resource Groups (SRG). These SRG's are groupings of soil series, soils types and land capability units. For a detailed description of these SRG's, see Appendix I of this report. In a further aggregation, Soil Resource Groups were grouped for mapping purposes into Soil Management Groups (SMG). Each SMG contains certain SRG's which require similar management

practics. These SMG's can be used to establish cropping patterns within a given land area such as a watershed. A more detailed description is presented in Appendix I of this report.

General Economic Characteristics

Major Types of Economic Activity Agricultural production within the Basin is highly diversified, including dairy products, row crops, truck crops, poultry, livestock, fruits, vegetables and general farm crops. In 1960, 91,000 people, about three percent of the total population, were engaged in agricultural production. Numerous other people were engaged in transporting, processing, and marketing the produce.

In Subarea One, the major type of economic activity is lumbering and forest related activities. About three-fourths of the Basin forest land is in Subarea One and the northern part of Subarea Two. Recreation and tourism are also important in these areas.

Agricultural production is a major segment of Subareas Two, Three and Five. Nearly 83 percent of the Basin's total cropland (over 6.8 million acres) is in these three subareas.

Although Subarea Four is also an important producer of agricultural products, it is the industrial center of the Basin. One of the important manufactured products is farm machinery and equipment, employing over 11,000 workers in 1964. Another important product is manufactured food and kindred products. These include firms engaged in brewing, meat packing, dairy products processing, and related activities, employing over 22,000 workers in 1964. Other manufactured products include automobiles, primary and intermediate metal products, paper and printing products, electrical and non-electrical machinery, and textile, apparel and leather products.

Farm Characteristics The average size of farms in the Basin was 167.6 acres in 1969, a 14 percent increase over the 1959 level (Table 4). Average farm size in the Basin is increasing more slowly than for the entire United States. In 1959, farms were 48.5 percent of the national average. By 1964, the proportion had dropped to 44.5 percent. There was a marked difference in size of farms among the subareas. In 1969, Subarea One was 236 acres compared to 135 and 147 acres in Subareas Three and Four, respectively.

Type of farm is a classification based upon the major source of farm income. To be classified as a particular type, at least 50 percent of the total value of farm sales must have resulted from the sale of that commodity. The major type of farming operations in terms of numbers of farms are (1) livestock, dairy, and poultry, and (2) miscellaneous and unclassified farms

Table 4. Average Size of Farm, Southeast Wisconsin Rivers Basin, With Comparisons 1959, 1964, and 1969. 1/

Subareas	Average Size of Farm 1959	1964	1969
		Acre	
1	190.1	202.3	236.7
2	153.7	162.0	171.3
3	118.0	123.9	134.9
4	124.4	132.4	146.9
5	160.3	171.3	182.2
Basin	146.9	156.4	167.6
United States	302.8	351.6	
Basin/United States	48.5%	44.5%	

1/ Source: U.S. Census of Agriculture, 1959, 1964 and 1969.

(Table 5). Cash grain farms, general farms and those including the growing of vegetables, fruit and nuts, and other field crops comprise only a small proportion of the Basin total.

The 33,078 livestock, dairy, and poultry farms represent nearly two-thirds of the total number of Basin farms in 1969. The number of these farms decreased from 1964 to 1969 by 9,147 farms. In 1964, the Basin contained 4 percent of all the livestock, dairy, and poultry farms in the United States. This type of farm is popular in every subarea.

Over one-fourth of the 1969 Basin farms are categorized as miscellaneous and unclassified. This classification includes all of those farms which do not have fifty percent or more of total farm sales from commodities listed in other classifications of Table 5. The total number of these farms remained almost constant from 1959 to 1969.

Although their total number is relatively small, the proportion of farms classified as vegetable, fruit, nuts, and other field crops increased from 1959 to 1964. As a percentage of the total United States number, this increase was from 0.9 percent to 1.2 percent.

The number of cash grain farms and general farms increased between 1959 and 1964. However, as a percentage of the United States total number of these type of farms, there was not much change. The cash grain percentage did not change and the general farm percentage increased from 1.1 percent to 1.8 percent. The number of 1969 general farms decreased to nearly half of the 1964 number while the number of cash grain farms increased.

For further historical information on these and other physical and economic characteristics, see Technical Report No. 1, A Description of the Agricultural Economy of the Southeast Wisconsin Rivers Basin.

Table 5. Number of Farms by Type, Southeast Wisconsin Rivers Basin, With Comparisons, 1959, 1964, and 1969. 1/

Subareas	Cash Grain		
	1959	1964	1969
	Number		
1	11	16	14
2	235	282	329
3	85	112	151
4	626	642	572
5	912	1,150	1,267
Basin	1,869	2,202	2,333
United States	398,047	204,253	
Basin/United States	0.5%	0.5%	

Subareas	Livestock, Dairy & Poultry		
	1959	1964	1969
	Number		
1	2,036	1,744	1,169
2	14,771	12,496	8,580
3	9,792	8,381	6,989
4	5,700	4,425	3,439
5	17,832	15,179	12,900
Basin	50,131	42,225	33,078
United States	1,164,998	963,616	
Basin/United States	4.3%	4.4%	

Subareas	General		
	1959	1964	1969
	Number		
1	107	86	55
2	647	813	429
3	225	597	340
4	356	632	265
5	1,190	1,412	727
Basin	2,525	3,540	1,816
United States	211,613	201,980	
Basin/United States	1.1%	1.8%	

Table 5. (Continued)

Subareas	Vegetables, Fruit, Nuts Other Field Crops 1959	1964	1969
	Number		
1	17	74	71
2	428	501	470
3	306	362	345
4	306	285	247
5	158	194	255
Basin	1,215	1,416	1,388
United States	121,663	115,593	
Basin/United States	0.9%	1.2%	

Subareas	Miscellaneous & Unclassified 1959	1964	1969
	Number		
1	1,513	1,114	780
2	3,567	3,538	4,981
3	2,501	2,411	2,198
4	2,481	2,430	2,210
5	3,138	3,213	3,331
Basin	13,200	12,706	13,500
United States	1,814,182	1,472,415	
Basin/United States	0.7%	0.9%	

Subareas	Total 1959	1964	1969
	Number		
1	3,684	3,034	2,089
2	19,648	17,630	14,789
3	12,909	11,863	10,023
4	9,469	8,414	6,733
5	23,230	21,148	18,481
Basin	68,940	62,089	52,115
United States	3,710,503	3,157,857	
Basin/United States	1.9%	2.1%	

1/ Compiled from U.S. Census of Agriculture, 1959, 1964, and 1969.

SOCIO-ECONOMIC CHARACTERISTICS

Introduction

The major socio-economic characteristics of the Basin include population, employment and income. These factors are closely related to the economic activity and the output produced within the Basin.

Between 1960 and 1970, population in the study area increased relatively faster than for the entire State of Wisconsin, a 13% increase compared to 11.8%. The greatest increase occurred in Subarea Five while Subarea One had a decrease in population.

There are seven Standard Metropolitan Statistical Areas (SMSA), based upon the preliminary information of the 1970 Census of Population. Three of these (Milwaukee, Kenosha and Racine, Wisconsin) are in Subarea Four. Two (Madison, Wisconsin and Rockford, Illinois) are in Subarea Five. One (Green Bay, Wisconsin) is in Subarea Three and the other (Appleton-Oskosh, Wisconsin) is in Subarea Two. Six additional Wisconsin cities have over 39,000 population. The five within the Basin are Sheboygan in Subarea Three, Janesville in Subarea Five and Waukesha, Wauwatosa and West Allis in Subarea Four. The location of these cities aptly illustrates that Subarea Four is highly industralized and is dominated by its urban influence. Subarea Five has a different type of urban influence through Madison, which is the state capitol and contains the major state university campus. The other subareas comprise the northern and central portion of the Basin and have more rural influence.

Industrial growth, measured by number of employees, shows variation among subareas. Between 1940 and 1960, Subarea One had a relatively large increase in mining, apparel manufacturing, and chemicals and allied products manufacturing, with a decrease in agriculture and a decrease in motor vehicle and equipment manufacturing. Subarea Two had growth in the manufacturing of textile mill products and other transportation equipment. Industrial growth in Subarea Three included the manufacturing of textile mill products, apparel, and chemicals and allied products. This area had a decline in forestry and fisheries and the armed forces. Subarea Four grew in forestry and fisheries and motor vehicle and equipment along with a decline in textile mill products, apparel, chemicals and allied products, and other transportation equipment. Apparel manufacturing declined in Subarea Five, however, agriculture, forestry and fisheries, other transportation equipment manufacturing, and the armed forces had increased growth.

The Wisconsin State Capital is located in Madison within Subarea Five. The major governmental institutions of Wisconsin and some major Federal agency offices are located there. In addition, field offices of a number of the Federal and State agencies concerned with the Basin's land and water resources are located at the county level.

The University of Wisconsin, with the largest campuses at Madison, main campus in Madison and Milwaukee and Green Bay, contributes much to the economy. Other universities and colleges are scattered throughout the Basin.

According to Article 9, Section 1 of the Wisconsin Constitution, the state has jurisdiction over all waters bordering the state and all navigable waters within the state. This, along with an extremely liberal definition of

navigable, means that the state potentially has a far reaching power to deal with water-related problems. The state has used this power to impose a wide range of controls, including the regulation of dam construction, irrigation, channel encroachments, discharge of wastes, construction of water supply facilities by private and municipal entities, level and rate of flow and other such controls.

The state has many agencies that deal with water resource management, the main one being the Department of Natural Resources. Others include the Natural Resources Board, Natural Resources Council of State Agencies, Department of Health and Social Services, Department of Local Affairs and Development, and the University of Wisconsin. Each of these agencies have many branches and departments concerned with various phases of water resource development. In addition, there are regional planning commissions and other regional and local entities dealing with problems of water resource development.

Population

Total Population The Wisconsin Department of Local Affairs and Development, has published a development series which deals with the social and economic characteristics of Wisconsin. Information from these reports indicate that Subarea One and portions of Subarea Two have a declining population which remains predominantly rural, comparatively older, and somewhat less well-educated than the Basin average. Consistent with the characteristics of rural areas, they contain proportionately more males than females, and are experiencing marked outmigration, especially of the economically-active 15-44 age group. The entire population (approximately 2,600) of Menominee County in Subarea Two is American Indian.

Subarea Three has a population that is younger and slightly less educated than the Basin average. It contains more females than males and is experiencing some outmigration.

In contrast, Subareas Four and Five have a rapidly growing population which is comparatively younger, more urban, and more educated than the Basin average. They contain more females than males and have inmigration, especially of the economically-active 15-44 age group.

Table 6 illustrates these population changes between 1960 and 1970 at the county and subarea level.

Between 1950 and 1970, the Basin population has increased 37 percent, indicating its steady growth over the past decades (Table 7). To facilitate differentiation, the projections in Table 7 were labeled as types X, Y and Z. The type X projections were based upon a calculated annual compound growth rate for each individual subarea and based upon the 20 year period, 1950 to 1970. The calculated rates were: Subarea One (negative 0.35 percent), Subarea Two (1.11 percent), Subarea Three (1.44 percent), Subarea Four (1.75 percent) and Subarea Five (1.95 percent). Beyond birth and death rates, these growth rates include the effect of migration. Based upon the type X projections, population increased by 32 percent between 1960 and 1980, 38 percent between 1980 and 2000 and 39 percent between 2000 and 2020.

The types Y and Z projections are based upon the Census Bureau growth rates assuming medium-low and low birth rates, respectively. The medium-low rate is one percent and the low growth rate is 0.9 percent. These rates are based upon birth and death rates and are applicable to the nation. Therefore, they do not account for population shifts through migration. This is illustrated by Subarea One in Table 7. Historical data and type

Table 6. Population by Counties, Southeast Wisconsin Rivers Basin, 1960, 1970 and Percent Change. 1/

County 2/	1960	1970	Percent Change
Subarea 1			
Florence	3,437	3,298	- 4.0
Forest	7,542	7,691	2.0
Marinette	34,660	35,810	3.3
Dickinson, Michigan	23,917	23,753	- 0.7
Iron, Michigan	17,184	13,813	-19.6
Menominee, Michigan	24,685	24,587	- 0.4
Total	111,425	108,952	- 2.2
Subarea 2			
Fond du Lac	75,085	85,567	12.6
Green Lake	15,418	16,878	9.5
Langlade	19,916	19,220	- 3.5
Marquette	8,516	8,865	4.1
Menominee	- 3/	2,607	-
Oconto	25,110	25,553	1.8
Outagamie	101,794	119,356	17.3
Shawano	34,351	32,650	- 5.0
Waupaca	35,340	37,780	6.9
Waushara	13,497	14,795	9.6
Winnebago	107,928	129,931	20.4
Total	436,955	492,202	12.6
Subarea 3			
Brown	125,082	158,244	26.5
Calumet	22,268	27,604	24.0
Door	20,685	20,106	- 2.8
Kewaunee	18,282	18,961	3.7
Manitowoc	75,215	82,294	9.4
Sheboygan	86,484	96,660	11.8
Total	348,016	403,869	16.0
Subarea 4			
Kenosha	100,615	117,917	17.2
Milwaukee	1,036,041	1,054,063	1.7
Ozaukee	38,441	54,421	41.6
Racine	141,781	170,838	20.5
Walworth	52,368	63,444	21.2
Washington	46,119	63,839	38.4
Waukesha	158,249	231,365	46.2
Total	1,573,664	1,755,887	10.7

Continued

Table 6. (Continued)

County	1960	1970	Percent Change
Subarea 5			
Dane	222,095	290,272	30.7
Dodge	63,170	69,004	9.2
Green	25,851	26,714	3.3
Iowa	19,631	19,306	- 1.7
Jefferson	50,094	60,060	19.9
Lafayette	18,142	17,456	- 3.8
Rock	113,913	131,970	15.9
Stephenson, Illinois	46,207	48,861	5.7
Winnebago, Illinois	209,765	246,623	17.6
Total	768,868	910,266	18.4
TOTAL BASIN	3,238,928	3,671,176	13.3
TOTAL WISCONSIN	3,951,777	4,417,933	11.8

1/ Source: 1960 Census of Population and Preliminary Statistics 1970 Census of Population.

2/ Counties are Wisconsin, unless otherwise noted.

3/ Included in Oconto and Shawano Counties.

Table 7. Population by Subarea, Southeast Wisconsin Rivers Basin, 1950, 1960, 1970, and Projected to 1980, 2000 and 2020.

Projection Series		Historical 1/			Projected		
		1950	1960	1970	1980	2000	2020
		---1000---					
Subarea 1							
	X 2/	116.8	111.4	109.0	105.2	98.2	91.6
	Y 3/				120.9	147.5	179.9
	Z 4/				119.7	143.2	171.2
Subarea 2							
	X	396.7	437.0	492.2	548.2	680.2	844.0
	Y				543.7	663.3	809.4
	Z				538.3	643.9	770.3
Subarea 3							
	X	303.2	348.0	403.9	446.1	620.9	827.1
	Y				446.3	544.3	644.1
	Z				441.7	528.4	632.0
Subarea 4							
	X	1,240.6	1,573.7	1,755.9	2,088.9	2,956.5	4,184.4
	Y				1,958.8	2,437.8	3,033.8
	Z				1,920.4	2,297.2	2,747.8
Subarea 5							
	X	618.7	768.9	910.3	1,104.1	1,624.4	2,389.8
	Y				1,005.3	1,236.4	1,496.7
	Z				995.5	1,190.8	1,424.4
Basin							
	X	2,676.0	3,239.0	3,671.3	4,312.5	5,980.2	8,336.9
	Y				4,075.0	5,029.3	6,163.9
	Z				4,015.6	4,803.5	5,745.7

1/ Historical data is based upon the Census of Population.

2/ Projection based on compound annual growth rate calculated for each subarea between 1950 and 1970.

3/ Census Bureau Medium-low growth rate of 1 percent per year, Series D.

4/ Census Bureau Low growth rate of 0.9 percent per year, Series E.

X projections indicate a reduction in population while the Census series predict an increase. The decrease is undoubtedly due to the incidence of outmigration from Subarea One.

Rural Farm Population Rural farm population is directly related to agricultural employment. Agricultural employment numbers are directly related to projected agricultural production and land use patterns. Farm population has been estimated using historical relationships between employment and population.

Total rural farm population is expected to decrease 46 percent between 1980 and 2020 (Table 8). This varies from a 42 percent decrease in Subarea Two to a 58 percent decrease in Subarea One. These projections are based on fully employed farm workers. In contrast, historical data from the census defines a broader spectrum of individuals as farmers, including those who are underemployed or who have off-farm sources of income. Due to this difference in definition, farm population projections based on a fully-employed concept will be less than projections based on the census definition. This should be kept in mind when comparing the historical and projected data.

One of the factors behind the decline in rural farm population is the decline in agricultural employment associated with increasing productivity. This increased productivity and the continued movement to larger equipment and operating units results in fewer farms. Total farm numbers are projected to decline 62 percent between 1969 and 2020 (Table 9). These projections are based on a historically derived relationship of one farm for each 4.1 individuals in the farm population.

Table 8. Rural Population by Subarea, Southeast Wisconsin Rivers Basin, 1950, 1960, 1970, and Projections to 1980, 2000 and 2020.

Subarea	Residence	Historical 1/ 1950	1960	1970	Projected 2/ 1980	2000	2020
		1,000					
1	Farm	26.0	14.1	7.7	3.8	2.2	1.6
	Rural NonFarm	43.4	48.9	55.3	53.4	49.7	45.5
	Total Rural	69.4	63.0	63.0	57.2	51.9	47.1
2	Farm	107.7	84.2	65.7	45.6	29.9	26.3
	Rural NonFarm	96.8	124.6	153.3	178.0	209.6	230.2
	Total Rural	204.5	208.8	219.0	223.6	239.5	256.5
3	Farm	68.3	56.1	46.1	31.4	21.1	17.8
	Rural NonFarm	63.5	74.4	94.0	107.3	126.3	139.0
	Total Rural	131.8	130.5	140.1	138.7	147.4	156.8
4	Farm	61.5	37.4	22.7	15.1	9.5	7.5
	Rural NonFarm	152.0	160.0	188.1	179.7	182.8	183.3
	Total Rural	213.5	197.4	210.8	194.8	192.3	190.8
5	Farm	116.8	98.6	83.3	56.7	36.2	28.5
	Rural NonFarm	118.5	155.5	189.0	237.3	304.0	365.1
	Total Rural	235.3	254.1	272.3	294.0	340.2	393.6
Basin							
	Farm	380.3	290.4	225.5	152.6	98.9	81.7
	Rural NonFarm	474.2	563.4	679.7	755.7	872.4	963.1
	Total Rural	854.5	853.8	905.2	908.3	971.3	1,044.8

1/ The 1950, 1960 and 1970 data are from the respective Census of Population.

2/ The farm projections are based upon full-time agricultural employment only. The rural nonfarm projections are based upon a compound annual growth rate calculated for each subarea between 1950 and 1970.

Table 9. Number of Farms, Southeast Wisconsin Rivers Basin, 1964, 1969 and Projections to 1980, 2000 and 2020. 1/

		1964	1969	1980	2000	2020
Subarea						
	1	3,034	2,089	935	542	396
	2	17,630	14,789	11,114	7,285	6,421
	3	11,863	10,023	7,664	5,154	4,329
	4	8,414	6,733	3,672	2,309	1,833
	5	21,148	18,481	13,836	8,830	6,958
Basin		62,089	52,115	37,221	24,120	19,937

1/ Historical data is from the U.S. Census of Agriculture, 1964 and 1969. Projections are based on a historically derived relationship of one farm for each 4.1 individuals in the farm population.

Rural Nonfarm Population Historical data on the rural nonfarm population for the years 1950, 1960 and 1970 were obtained from the Census of Population (Table 8). The projections were calculated in nearly the same manner as the Type X projection of the total population. A percentage change was calculated for the 20-year period 1950 to 1970 for total rural population. This rate was then applied to the 1960 data to obtain the change in numbers to 1980. The same percentage change applied to the 1980 level gives the increase to 2000 and the same procedure was used to obtain the 2020 level. Then the projected farm population was subtracted to obtain rural nonfarm population.

Subareas Two and Five are estimated to have the greatest increase in rural nonfarm population. From 1970 to 2020, rural nonfarm population is projected to increase 50 percent in Subarea Two and 93 percent in Subarea Five. This is compared to the Basin increase of 42 percent. However, it must be remembered that these estimates are based on the 1950 to 1970 percentage change and thus, do not take into account any future change in the rate of rural nonfarm population change. This rate of change could vary from a difference in birth rate, death rate, migration rate or the rate at which these rural nonfarm areas become settled densely enough to be redefined as urban areas.

Urban Population Urban population, calculated as total population minus rural population, is projected to increase in all subareas except Subarea One (Table 10). Subareas Three, Four and Five are expected to more than double their urban population between 1980 and 2020, while Subarea One is projected to decrease by 7.3 percent.

Table 10. Urban Population by Subarea, Southeast Wisconsin Rivers Basin, 1950, 1960, 1970, and Projections to 1980, 2000 and 2020.

Subarea	Historical 1/			Projected 2/		
	1950	1960	1970	1980	2000	2020
	1,000					
1	47.4	48.4	46.0	48.0	46.3	44.5
2	192.2	228.1	273.1	309.8	425.5	572.9
3	171.4	217.5	263.7	327.4	473.5	670.3
4	1,027.1	1,376.3	1,545.1	1,894.1	2,764.2	3,993.6
5	383.4	514.7	637.9	810.1	1,284.2	1,996.2
Basin	1,821.4	2,385.1	2,765.9	3,389.4	4,993.7	7,277.5

1/ Historical data obtained from Census of population, 1960 and 1970.

2/ Projected figures are residual from total population minus rural population.

Employment

Total employment increased from 1,044,255 in 1950 to 1,184,358 in 1960 (13 percent). From 1940 to 1950, the increase was 32 percent. Subarea Four had 47.5 percent of the 1960 total employment, while Subarea One had only three percent.

Table 11 shows total employment within 32 industry groups for 1940, 1950 and 1960. The coefficient of localization, which is also presented in this table, indicates the degree to which an industry is concentrated within one or more subareas. The change in the coefficient from one period to another indicates whether an industry is becoming more or less concentrated. The coefficient is small when the industry is distributed among subareas in nearly the same proportion as total employment. It is large when an industry's employment is concentrated in one or more subareas.

Tables 12, 13, 14, 15 and 16 show the number employed in each subarea for each of the 32 industry groups, both in absolute terms and as a percentage of the Basin's total employment in each industry. For example, Table 13 shows that Subarea Two employed 24,082 people in agriculture, which was 27.59 percent of the total agricultural employment.

Use of the coefficient of localization in conjunction with Tables 12 through 16 gives a direct indication of dispersion or concentration of an industry within subareas. For example, mining in 1960 shows a coefficient of 0.5535 and examination of the subarea tables shows that Subarea One employs over 58 percent of the mine workers but only three percent of the Basin's total employment. The other subareas have relatively less mining employment than their share of total employment. Another use of this

Table 11. Total Basin Employment by Industry Group, Southeast Wisconsin Rivers Basin, 1940, 1950, and 1960[1/]

Industry	Total Industry Employment 1940	1950	1960	Coefficient of Localization 1940	1950	1960
1. Agriculture	142,382	130,150	87,287	0.2916	0.3198	0.3456
2. Forestry & fisheries	1,177	1,479	1,200	0.4114	0.3235	0.1712
3. Mining	2,781	3,416	3,395	0.5094	0.5334	0.5535
4. Contract construction	30,941	52,325	56,954	0.0368	0.0208	0.0120
5. Food & kindred products mfg.	30,962	43,080	48,835	0.0858	0.0442	0.0522
6. Textile mill products mfg.	11,729	10,600	6,376	0.2193	0.1158	0.2143
7. Apparel mfg.	4,514	8,063	6,358	0.2353	0.2054	0.1773
8. Lumber, wood products, furn. mfg.	23,437	27,976	20,169	0.2469	0.2803	0.3478
9. Printing & publishing mfg.	12,064	17,915	24,240	0.1557	0.1280	0.0971
10. Chemicals & allied products mfg.	3,810	5,736	7,238	0.2179	0.1562	0.1059
11. Electrical & other machinery mfg.	53,150	102,668	134,587	0.2470	0.2094	0.1589
12. Motor vehicles & equipment mfg.	15,823	27,753	40,517	0.2417	0.2600	0.2587
13. Other transportation equipment mfg.	2,296	5,318	8,752	0.3356	0.2864	0.2547
14. Other & miscellaneous mfg. 2/	86,960	121,650	135,297	0.0901	0.0627	0.0749
15. Railroads & railway express	15,039	16,621	10,866	0.0820	0.0748	0.1121
16. Trucking & warehousing	7,605	12,558	16,109	0.0523	0.0378	0.0321
17. Other transportation	5,524	9,432	7,897	0.2107	0.1489	0.1543
18. Communications	7,566	11,989	12,943	0.0762	0.0656	0.0295
19. Utilities & sanitary service	9,084	13,761	14,933	0.0895	0.0873	0.0742
20. Wholesale trade	20,219	32,498	33,989	0.0739	0.0550	0.0496
21. Food & dairy products stores	26,372	30,036	31,568	0.0544	0.0135	0.0258
22. Eating and drinking places	21,356	32,699	36,346	0.0438	0.0081	0.0286
23. Other retail trade	65,953	91,017	106,352	0.0483	0.0166	0.0060
24. Finance, insurance & real estate	21,508	28,363	38,974	0.1617	0.1033	0.0825
25. Hotels and other personal services	24,061	26,875	27,394	0.0622	0.0356	0.0200
26. Private households	28,973	17,118	20,357	0.0212	0.0491	0.0694
27. Business & repair services	14,994	23,279	24,477	0.0292	0.0082	0.0407
28. Entertainment, recreation services	5,475	8,097	7,164	0.1068	0.0270	0.0512
29. Medical, other professional services	61,073	84,736	130,116	0.0455	0.0506	0.0559
30. Public administration	24,300	32,810	41,907	0.0847	0.0691	0.0576
31. Armed forces	299	2,027	4,607	0.2833	0.2197	0.2447
32. Industry not reported	10,906	12,210	37,154	0.0320	0.0130	0.0958
Total Employment	792,333	1,044,255	1,184,358			

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

Table 12. Total Employment by Industry Group, Subarea 1, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960[1/]

Industry	Total Industry Employment 1940	1950	1960	Percent of Basin 1940	1950	1960
1. Agriculture	8,088	7,371	3,396	5.68	5.66	3.89
2. Forestry & fisheries	225	303	170	19.12	20.49	14.17
3. Mining	1,532	1,947	1,981	55.09	57.00	58.35
4. Contract construction	1,064	1,556	1,890	3.44	2.97	3.32
5. Food & kindred products mfg.	569	636	798	1.84	1.48	1.63
6. Textile mill products mfg.	64	244	98	0.55	2.30	1.54
7. Apparel mfg.	48	352	363	1.06	4.37	5.71
8. Lumber, wood products, furn. mfg.	3,631	4,410	3,080	15.49	15.76	15.27
9. Printing & publishing mfg.	277	347	449	2.30	1.94	1.85
10. Chemicals & allied products mfg.	127	306	501	3.33	5.33	6.92
11. Electrical & other machinery mfg.	374	516	950	0.70	.50	0.71
12. Motor vehicles & equipment mfg.	1,364	1,047	69	8.62	3.77	0.17
13. Other transportation equipment mfg.	98	118	439	4.27	2.22	5.02
14. Other & miscellaneous mfg. 2/	1,925	3,080	3,329	2.21	2.53	2.46
15. Railroads & railway express	608	672	416	4.04	4.04	3.83
16. Trucking & warehousing	292	389	390	3.84	3.10	2.42
17. Other transportation	155	305	200	2.81	3.23	2.53
18. Communications	240	377	443	3.17	3.14	3.42
19. Utilities & sanitary service	351	425	495	3.86	3.09	3.31
20. Wholesale trade	583	836	854	2.88	2.57	2.51
21. Food & dairy products stores	1,106	1,197	1,087	4.19	3.99	3.44
22. Eating and drinking places	909	1,284	1,285	4.26	3.93	3.54
23. Other retail trade	2,473	2,924	3,243	3.75	3.21	3.05
24. Finance, insurance & real estate	388	464	636	1.80	1.64	1.63
25. Hotels and other personal services	904	928	999	3.76	3.45	3.65
26. Private households	1,051	526	665	3.63	3.07	3.27
27. Business & repair services	518	818	527	3.45	3.51	2.15
28. Entertainment, recreation services	219	301	169	4.00	3.72	2.36
29. Medical, other professional services	2,294	2,830	3,990	3.76	3.34	3.07
30. Public administration	972	1,195	1,316	4.00	3.64	3.14
31. Armed forces	0	27	31	0.00	1.33	0.67
32. Industry not reported	452	466	1,298	4.14	3.82	3.49
Total Employment	32,901	38,197	35,557	4.15	3.66	3.00

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

Table 13. Total Employment by Industry Group, Subarea II, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960[1/]

Industry	Total Industry Employment 1940	1950	1960	Percent of Basin 1940	1950	1960
1. Agriculture	40,727	35,959	24,082	28.60	27.63	27.59
2. Forestry & fisheries	170	208	143	14.44	14.06	11.92
3. Mining	241	319	278	8.67	9.34	8.19
4. Contract construction	4,317	6,981	7,631	13.95	13.34	13.40
5. Food & kindred products mfg.	3,637	5,359	7,194	11.75	12.44	14.73
6. Textile mill products mfg.	1,562	2,648	2,212	13.32	24.98	34.69
7. Apparel mfg.	787	1,355	1,256	17.43	16.81	19.75
8. Lumber, wood products, furn. mfg.	6,014	6,154	5,615	25.66	22.00	27.84
9. Printing & publishing mfg.	1,521	2,191	3,202	12.61	12.23	13.21
10. Chemicals & allied products mfg.	146	256	252	3.83	4.46	3.48
11. Electrical & other machinery mfg.	1,747	4,645	215	3.29	4.52	5.36
12. Motor vehicles & equipment mfg.	1,118	1,900	2,753	7.07	6.85	6.79
13. Other transportation equipment mfg.	80	173	907	3.48	3.25	10.36
14. Other & miscellaneous mfg.	12,271	18,186	21,394	14.11	14.95	15.81
15. Railroads & railway express	2,360	2,759	1,792	15.69	16.60	16.49
16. Trucking & warehousing	958	1,445	1,912	12.60	11.51	11.87
17. Other transportation	409	705	475	7.40	7.47	6.01
18. Communications	912	1,469	1,595	12.05	12.25	12.32
19. Utilities & sanitary service	934	1,567	1,644	10.28	11.39	11.01
20. Wholesale trade	2,175	3,840	3,836	10.76	11.82	11.29
21. Food & dairy products stores	3,600	4,298	4,188	13.65	14.31	13.27
22. Eating and drinking places	3,085	4,721	5,292	14.45	14.44	14.56
23. Other retail trade	8,724	12,203	13,640	13.23	13.41	12.83
24. Finance, insurance & real estate	2,040	2,986	3,964	9.48	10.53	10.17
25. Hotels and other personal services	2,988	3,314	3,537	12.42	12.33	12.91
26. Private households	4,912	2,729	2,972	16.95	15.94	14.60
27. Business & repair services	2,173	3,281	3,108	14.49	14.09	12.70
28. Entertainment, recreation services	676	1,141	911	12.35	14.09	12.72
29. Medical, other professional services	8,299	10,353	15,951	13.59	12.22	12.26
30. Public administration	2,680	3,534	4,195	11.03	10.77	10.01
31. Armed forces	0	95	174	0.00	4.69	3.78
32. Industry not reported	1,915	1,835	3,707	17.56	15.03	9.98
Total Employment - Subarea II	123,178	148,609	157,027	15.55	14.23	13.26

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

Table 14. Total Employment by Industry Group, Subarea III, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960 1/

Industry	Total Industry Employment 1940	1950	1960	Percent of Basin 1940	1950	1960
1. Agriculture	27,859	24,194	16,004	19.57	18.59	12.33
2. Forestry & fisheries	451	400	196	38.32	27.05	16.33
3. Mining	125	84	81	4.49	2.46	2.39
4. Contract construction	3,339	5,762	6,267	10.79	11.01	11.00
5. Food & kindred products mfg.	4,563	5,360	6,408	14.74	12.44	13.12
6. Textile mill products mfg.	332	615	529	2.83	5.80	8.30
7. Apparel mfg.	170	567	754	3.77	7.03	11.86
8. Lumber, wood products, furn. mfg.	3,602	5,506	3,780	15.37	19.68	18.74
9. Printing & publishing mfg.	783	1,489	2,108	6.49	8.31	8.70
10. Chemicals & allied products mfg.	129	325	724	3.39	5.67	10.00
11. Electrical & other machinery mfg.	1,669	3,535	7,715	3.14	3.44	5.73
12. Motor vehicles & equipment mfg.	80	278	189	0.51	1.00	0.47
13. Other transportation equipment mfg.	761	2,136	2,141	33.14	40.17	24.46
14. Other & miscellaneous mfg. 2/	13,927	18,422	21,302	16.02	15.14	15.74
15. Railroads & railway express	1,723	1,982	1,487	11.46	11.92	13.68
16. Trucking & warehousing	853	1,581	1,957	11.22	12.59	12.15
17. Other transportation	734	1,280	912	13.29	13.57	11.55
18. Communications	680	1,198	1,222	8.99	9.99	9.44
19. Utilities & sanitary service	1,094	1,425	1,537	12.04	10.36	10.29
20. Wholesale trade	2,476	3,951	3,483	12.25	12.16	10.25
21. Food & dairy products stores	2,619	3,522	3,370	9.93	11.73	10.68
22. Eating and drinking places	2,458	3,753	4,304	11.51	11.48	11.84
23. Other retail trade	7,332	10,472	11,972	11.12	11.51	11.26
24. Finance, insurance & real estate	1,450	2,015	2,819	6.74	7.10	7.23
25. Hotels and other personal services	2,272	2,706	2,876	9.44	10.07	10.50
26. Private households	3,173	1,939	2,278	10.95	11.33	11.19
27. Business & repair services	1,672	2,556	2,182	11.15	10.98	8.91
28. Entertainment, recreation services	452	961	756	8.26	11.87	10.55
29. Medical, other professional services	6,074	8,053	11,673	9.95	9.50	8.97
30. Public administration	2,025	2,655	3,477	8.33	8.09	8.30
31. Armed forces	121	303	309	40.47	14.95	6.71
32. Industry not reported	1,168	1,300	3,240	10.71	10.65	8.72
Total Employment - Subarea III	96,166	120,325	128,052	12.14	11.52	10.81

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

Table 15. Total Employment by Industry Group, Subarea IV, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960[1]

Industry	Total Industry Employment 1940	1950	1960	Percent of Basin 1940	1950	1960
1. Agriculture	20,535	18,291	11,247	14.46	14.05	12.89
2. Forestry & fisheries	272	316	380	23.11	21.37	31.67
3. Mining	505	631	600	18.16	18.47	17.67
4. Contract construction	14,636	24,951	26,339	47.30	47.68	46.25
5. Food & kindred products mfg.	15,356	21,339	21,292	49.60	49.53	43.60
6. Textile mill products mfg.	7,688	4,967	2,334	65.55	46.86	37.55
7. Apparel mfg.	2,946	5,103	3,492	65.26	63.29	54.92
8. Lumber, wood products, furn. mfg.	6,215	7,875	4,646	26.52	28.15	23.04
9. Printing & publishing mfg.	7,141	10,539	13,854	53.19	58.83	57.15
10. Chemicals & allied products mfg.	2,492	3,072	3,807	65.41	53.56	52.60
11. Electrical & other machinery mfg.	32,881	67,011	85,246	61.86	65.27	63.34
12. Motor vehicles & equipment mfg.	10,020	19,960	29,705	63.33	71.92	73.31
13. Other transportation equipment mfg.	1,287	2,241	2,177	56.05	42.14	24.87
14. Other & miscellaneous mfg. 2/	42,394	58,341	61,856	48.75	47.96	45.72
15. Railroads & railway express	7,771	8,369	5,621	51.67	50.35	51.73
16. Trucking & warehousing	3,715	6,121	7,346	48.85	48.74	49.33
17. Other transportation	3,510	5,553	4,907	63.54	58.87	62.14
18. Communications	3,847	6,305	6,468	50.85	52.59	49.97
19. Utilities & sanitary service	4,776	7,535	8,147	52.58	54.76	54.56
20. Wholesale trade	10,291	16,541	17,813	50.90	50.90	52.41
21. Food & dairy products stores	12,927	14,047	15,650	49.02	46.77	49.58
22. Eating and drinking places	10,228	15,160	16,574	47.89	46.36	45.60
23. Other retail trade	31,955	43,405	50,573	48.45	47.69	47.55
24. Finance, insurance & real estate	12,860	15,986	21,708	59.79	56.36	55.70
25. Hotels and other personal services	11,842	13,026	12,630	49.22	48.47	46.10
26. Private households	12,521	7,172	8,247	43.22	41.90	40.51
27. Business & repair services	6,979	10,737	12,609	46.55	46.12	51.51
28. Entertainment, recreation services	2,973	3,913	3,766	54.30	48.33	52.57
29. Medical, other professional services	28,495	38,402	58,158	46.66	45.32	44.70
30. Public administration	11,827	16,896	21,307	48.67	51.50	50.84
31. Armed forces	126	1,309	1,792	42.14	64.58	38.90
32. Industry not reported	4,565	5,568	21,006	41.86	45.60	56.54
Total Employment - Subarea IV	345,626	480,682	561,957	43.62	46.03	47.45

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

Table 16. Total Employment by Industry Group, Subarea V, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960 1/

Industry	Total Industry Employment 1940	1950	1960	Percent of Basin 1940	1950	1960
1. Agriculture	45,123	44,335	32,558	31.69	34.06	37.30
2. Forestry & fisheries	59	252	311	5.01	17.04	25.92
3. Mining	378	435	455	13.59	12.73	13.40
4. Contract construction	7,585	13,075	14,827	24.51	24.99	26.03
5. Food & kindred products mfg.	6,837	10,386	13,143	22.08	24.11	26.91
6. Textile mill products mfg.	2,083	2,126	1,143	17.76	20.06	17.93
7. Apparel mfg.	563	686	493	12.47	8.51	7.75
8. Lumber, wood products, furn. mfg.	3,975	4,031	3,048	16.96	14.41	15.11
9. Printing & publishing mfg.	2,342	3,349	4,627	19.41	18.69	19.09
10. Chemicals & allied products mfg.	916	1,777	1,954	24.04	30.98	27.00
11. Electrical & other machinery mfg.	16,479	26,961	33,461	31.00	26.26	24.86
12. Motor vehicles & equipment mfg.	3,241	4,568	7,801	20.48	16.46	19.25
13. Other transportation equipment mfg.	70	650	3,088	3.05	12.22	35.28
14. Other & miscellaneous mfg. 2/	16,443	23,621	27,416	18.91	19.42	20.26
15. Railroads & railway express	2,577	2,839	1,550	17.14	17.08	14.26
16. Trucking & warehousing	1,787	3,022	3,904	23.50	24.06	24.23
17. Other transportation	716	1,589	1,403	12.96	16.85	17.77
18. Communications	1,887	2,640	3,215	24.94	22.02	24.84
19. Utilities & sanitary service	1,929	2,809	3,110	21.24	20.41	20.83
20. Wholesale trade	4,694	7,330	8,003	23.22	22.56	23.55
21. Food & dairy products stores	6,120	6,972	7,273	23.21	23.21	23.04
22. Eating and drinking places	4,676	7,781	8,891	21.90	23.80	24.46
23. Other retail trade	15,469	22,013	26,924	23.45	24.19	25.32
24. Finance, insurance & real estate	4,770	6,912	9,847	22.18	24.37	25.27
25. Hotels and other personal services	6,055	6,901	7,352	25.17	25.68	26.84
26. Private households	7,316	4,752	6,195	25.25	27.76	30.43
27. Business & repair services	3,652	5,887	6,051	24.36	25.29	24.72
28. Entertainment, recreation services	1,155	1,781	1,562	21.10	22.00	21.80
29. Medical, other professional services	15,911	25,098	40,344	26.05	29.62	31.01
30. Public administration	6,796	8,530	11,612	27.97	26.00	27.71
31. Armed forces	52	293	2,301	17.39	14.45	49.95
32. Industry not reported	2,806	3,041	7,903	25.73	24.91	21.27
Total Employment - Subarea V	194,462	256,442	301,765	24.54	24.56	25.48

1/ Source: Growth Patterns in Employment by County, 1940-1950 and 1950-1960, U.S. Dept. of Commerce, Office of Business Economics.

2/ Includes pulp and paper manufacturing.

coefficient of localization illustrates the change in the degree of concentration over time. Table 11 illustrates that agriculture, mining and the manufacture of lumber, wood and furniture products have become more concentrated. Some of the industries becoming less concentrated include forestry and fisheries, printing and publishing manufacturing, chemicals and allied products manufacturing, electrical and other machinery manufacturing, other transportation equipment manufacturing, other transportation, finance, insurance and real estate, and entertainment and recreation services.

Employment in agriculture declined from 1940 to 1960, but employment in all other major categories increased (Table 17). In 1940, agriculture accounted for 18 percent of the employed workers in the Basin, but by 1960 only seven percent worked in this category. New employment opportunities in urban areas and the decline in agricultural employment has resulted in a general loss of population from agriculturally orientated areas of the Basin.

Manufacturing was the most important component of employment in all three years, 1940, 1950 and 1960, accounting for 31 percent; 36 percent; and, 37 percent respectively of total employment in the Basin area.

Two categories, wholesale and retail trade and service activities employed about 18 percent of the Basin's employees in 1960. This percentage has changed little for both employment categories since 1940.

Employment accounted for by the remaining categories was 17 percent in 1940; 19 percent in 1950; and, 21 percent in 1960.

Table 17. Total Basin Employment by Major Industry Group, Southeast Wisconsin Rivers Basin, 1940, 1950 and 1960.

Industry 1/	Total Industry Employment 1940	1950	1960
Agriculture	142,382	130,150	87,287
Manufacturing	244,745	370,759	432,369
Services	134,576	160,105	209,508
Wholesale and Retail Trade	133,900	186,250	208,255
Contract Construction	30,941	52,325	56,954
Transportation and Communication	35,734	50,600	47,815
Public Administration	24,300	32,810	41,907
Other 2/	45,755	61,256	100,255
TOTAL	792,333	1,044,255	1,184,358

1/ Industry groups are aggregates from Table 11.
2/ Includes forestry and fisheries, mining, utilities and sanitary services, armed forces, finance, insurance and real estate, and all other industry not reported.

Agricultural Employment Total agricultural employment is projected to decrease 43 percent between 1980 and 2020 (Table 18). The comparison with 1960 data is not totally consistent because the projections are based on a full-time worker concept, while the Census also includes some seasonal and part-time workers. The decreasing level of agricultural employment over time is a continuation of the trend caused by increased productivity per man-hour and increased mechanization. This decrease would be more drastic if viewed as a percent of total employment because, while the number of agricultural employees is decreasing, the size of the total labor force is increasing. Hired labor requirements are also decreasing, partially due to increased mechanization in the production and harvesting process. The employment decrease between 1980 and 2020 ranges from 35 percent in Subarea Two to 52 percent in Subarea One.

Table 18. Agricultural Employment by Subarea, Southeast Wisconsin Rivers Basin, 1960, and Projections to 1980, 2000 and 2020. 1/

		Total Agricultural Employment 2/	Hired Workers	Farm Operators
Area 1				
	1960	3,396	481	2,915
	1980	1,128	227	901
	2000	694	140	554
	2020	541	109	432
Area 2				
	1960	26,147	3,936	22,211
	1980	13,402	2,694	10,708
	2000	9,334	1,876	7,458
	2020	8,775	1,764	7,011
Area 3				
	1960	16,031	2,347	13,684
	1980	9,242	1,858	7,384
	2000	6,604	1,327	5,277
	2020	5,916	1,189	4,727
Area 4				
	1960	12,873	3,300	9,573
	1980	5,681	1,142	4,539
	2000	3,572	718	2,854
	2020	2,890	581	2,309
Area 5				
	1960	32,558	5,981	26,577
	1980	21,407	4,303	17,104
	2000	13,661	2,746	10,915
	2020	10,972	2,205	8,767
Basin				
	1960	91,005	16,045	74,960
	1980	50,861	10,223	40,638
	2000	33,864	6,807	27,057
	2020	29,093	5,848	23,245

1/ 1960 figures are reported Census data; projections are based upon full-time agricultural employment only.

2/ These data are not completely comparable to that in Table 11 due to slight differences in the definition of agricultural employment between the 1960 Census of Population and that used in "Growth Patterns in Employment by County, 1940-1950 and 1950-1960," U.S. Department of Commerce, Office of Business Economics.

Income

The change in average income level per household between 1960 and 1968 is illustrated in Figure 3. The change in average income ranged from a $2,200 increase in Subarea Five to a $3,300 increase in Subarea Three. The Basin average income level increased 35.8 percent, from $7,789 to $10,581. The highest average household income level is in the highly urban industralized Subarea Four, while the lowest average is in the relatively sparsely populated Subarea One.

Major industry and service segments contributing to Basin income are manufacturing, wholesale and retail trade, service groups, and government (Table 19). Earnings from these sources totaled about seven billion dollars in 1966 or 78 percent of total earnings.

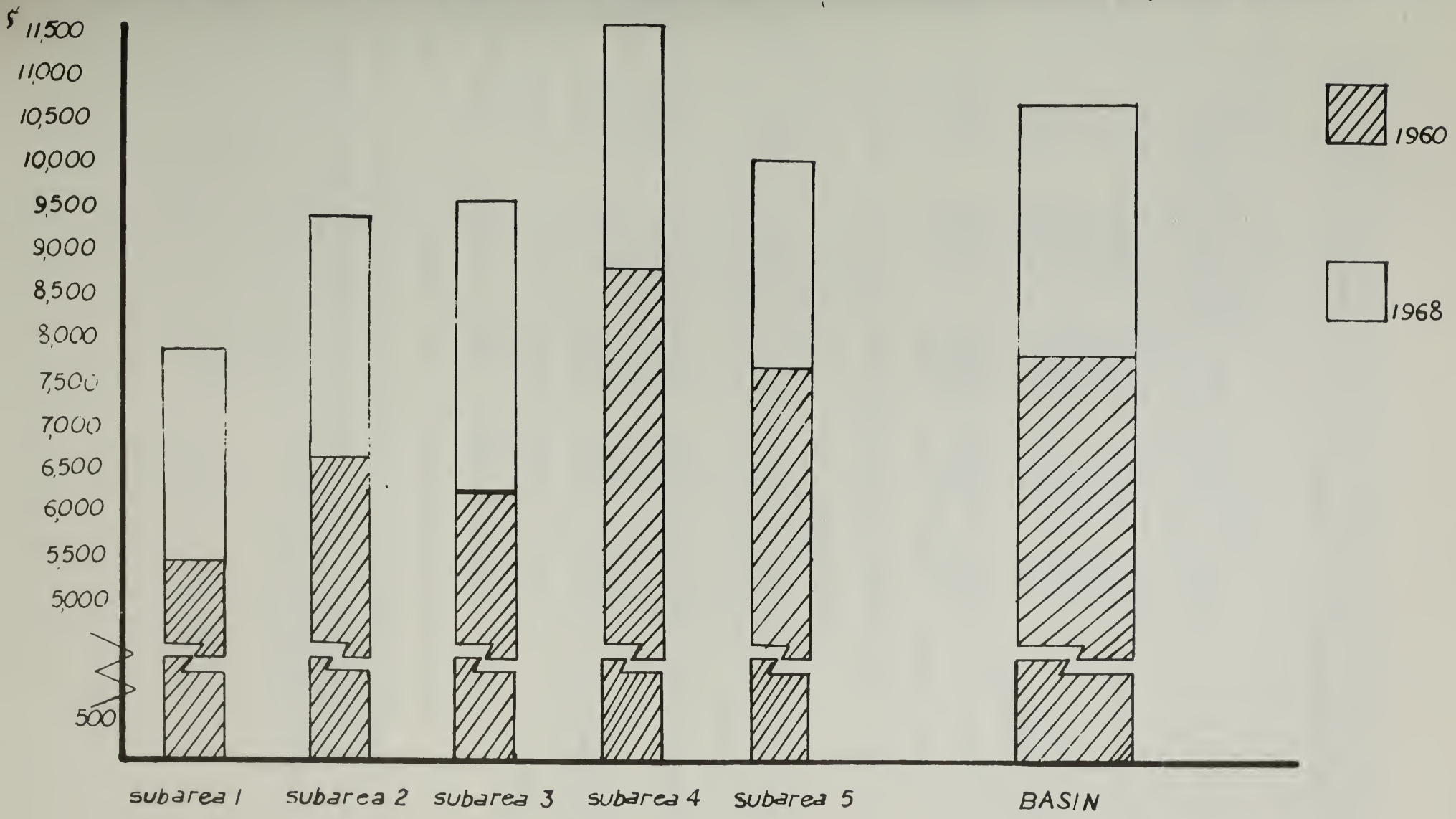
Other sources of earnings are: contract construction; transportation; communication and public utilities; agriculture; finance and insurance; mining, and other. Total earnings from these segments was about 1.9 billion dollars in 1966.

Manufacturing alone accounted for 40 percent of total earnings in 1966. This was unchanged from 1950, but dollar earnings from manufacturing increased from 1.5 billion dollars in 1950 to 3.6 billion dollars in 1966.

Farm earnings at approximately 452 million dollars was only five percent of total earnings in 1966. In 1950, farm earnings accounted for nine percent of total earnings.

From 1950 to 1966, government earnings increased from about 290 million dollars to slightly over one billion dollars. This increase (12 percent) was the largest shown for any earnings category for the 16-year period.

Figure 3. Average Household Income by Subarea, Southeast Wisconsin Rivers Basin, 1960 and 1968



SOURCE: 1960 — COUNTY AND CITY DATA BOOK, 1967.
1968 — THE STATE OF WISCONSIN BLUE BOOK, 1970

Table 19. Basin Earnings by Major Industry Groups by Economic Subareas, Southeast Wisconsin Rivers Basin 1950 and 1966. 1/

Industry Group	Subarea 1		Subarea 2		Subarea 3	
	1950	1966	1950	1966	1950	1966
	$1,000					
Manufacturing	32,490	62,320	144,200	400,780	133,630	369,720
Wholesale and Retail Trade	17,580	32,630	81,010	155,180	68,160	137,560
Services	8,980	17,030	36,980	108,580	29,330	86,270
Government	10,780	37,450	29,100	132,520	22,300	80,150
Contract Construction	3,980	15,130	24,460	63,020	19,540	52,600
Transportation, Communications & Public Utilities	5,490	9,720	27,170	49,010	26,060	47,980
Farm	10,520	7,060	74,740	99,780	48,090	65,040
Finance and Insurance	1,360	3,410	12,020	31,300	6,920	20,180
Mining	7,760	13,050	2,230	4,250	80	220
Other	890	800	1,380	4,340	1,610	2,590
TOTAL	99,830	198,600	433,290	1,048,760	355,720	862,310

Industry Group	Subarea 4		Subarea 5		Basin Total	
	1950	1966	1950	1966	1950	1966
	$1,000					
Manufacturing	959,360	2,159,180	201,150	571,220	1,470,830	3,563,220
Wholesale and Retail Trade	361,600	752,690	135,640	317,760	633,990	1,395,820
Services	181,690	557,300	68,590	229,990	325,570	999,170
Government	136,330	420,890	91,710	371,670	290,220	1,042,680
Contract Construction	123,000	322,840	45,470	142,390	216,450	595,980
Transportation, Communications & Public Utilities	130,720	280,640	47,780	97,880	237,220	485,230
Farm	47,560	59,290	154,140	220,730	335,050	451,900
Finance and Insurance	79,260	214,360	21,580	76,020	121,140	345,270
Mining	4,740	6,900	770	2,050	15,580	26,470
Other	3,210	6,420	3,850	9,730	10,940	23,880
TOTAL	2,027,470	4,780,510	770,680	2,039,440	3,686,990	8,929,620

1/ Source: Data for Wisconsin and Michigan counties from Department of Local Affairs and Development, State of Wisconsin. Data for Dickinson and Stephenson Counties, Illinois is estimated.

Other categories with increased earnings of at least two and one-half times from 1950 to 1960 were contract construction, finance and insurance, and services.

Agricultural Income. Net income from agricultural production is projected to increase 117 percent within the Basin between 1960 and 2020 (Table 20). This ranges from a 35 percent increase in Subarea Four to a 173 percent increase in Subarea Two. This corresponds to Subarea Four's decreasing share and Subarea Two's increasing share of the Basin agricultural production. These net income increases contain only the income from agricultural production and do not include government payments. The projections do contain non-money income such as farm produce used for home consumption and the rental value of the farm dwelling.

The income calculation procedure started with the total value of production. A cash receipts ratio was applied to this to obtain total cash receipts from farm marketings. A certain percentage of total cash receipts was added in as non-money income. For the Basin this percentage was estimated as 1960-11.6 percent, 1980-8.0 percent, 2000-7.5 percent, and 2020-7.0 percent. At this point, the resulting figure is gross income. Upon examining historical information from the Basin, it was found that approximately 75 percent of total cash receipts were production expenses. This amount was subtracted from gross income to obtain the agricultural net income figure.

The value of government payments was not included because of its uncertain nature from year to year.

Table 20. Net Agricultural Income by Subarea, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.1/

	Total Cash Receipts from Farm Marketing	Gross Income	Net Income
	----------$1000----------		
Area 1			
1960 2/	14,826	16,546	5,426
1980	18,439	19,914	6,085
2000	22,410	24,091	7,283
2020	26,941	28,827	8,621
Area 2			
1960	141,457	157,866	51,773
1980	234,096	252,824	77,252
2000	318,353	342,229	103,464
2020	441,490	472,394	141,276
Area 3			
1960	86,807	96,877	31,772
1980	144,118	155,647	47,559
2000	193,134	207,619	62,768
2020	259,198	277,342	82,944
Area 4			
1960	84,097	93,852	30,779
1980	94,831	102,417	31,294
2000	110,487	118,773	35,908
2020	129,580	138,651	41,466
Area 5			
1960	246,745	275,367	90,308
1980	376,756	406,896	124,329
2000	460,310	494,833	149,601
2020	566,948	606,634	181,423
Basin			
1960	573,932	640,508	210,059
1980	868,242	937,701	286,519
2000	1,104,694	1,137,546	359,026
2020	1,424,161	1,523,852	455,731

1/ Does not include Government Payments.

2/ For 1960, gross income and net income are calculated in the same manner as the projections. The cash receipts for 1960 were obtained from the 1960 Census.

LAND USE CHARACTERISTICS

The initial step in projecting land inventory patterns was to determine the acreage expansion of urban and built-up areas. It was assumed that this land use would take precedence over alternative uses in the future allocation of land. The increased acres reserved for urban expansion were then removed from the appropriate inventory acreage available to each of the other specified use categories for each of the projection periods. This, in addition to any other projected changes such as an increase in water or forest area, designated the acreage available for future utilization by each land use category.

Past Land Use Patterns Past land use patterns illustrate that urban areas are rapidly expanding, mainly at the expense of pasture and cropland (Table 21). Subarea Four, which contains Milwaukee and the surrounding metropolitan areas, shows the largest (10 percent) increase in size of the urban area between 1958 and 1967. This is associated with a 7.7 percent decrease in cropland and a 2.5 percent decrease in pasture. Subareas Three and Five illustrate a somewhat smaller shift in land use and Subareas One and Two show a much smaller shift. Within the entire Basin, urban acreage increased 2.0 percent while cropland decreased 1.4 percent and pasture decreased 2.0 percent.

Projected Land Inventory Patterns As the economic activity, population growth, urbanization, and associated services increase, more pressure will be placed upon the agricultural and forestry resources.

Table 21. Land Use Summary, Southeast Wisconsin Rivers Basin, 1958 and 1967. 1/

	Year 1958	1967	Percent Change
	Percent		
Area 1			
Water	0.5	0.4	-0.1
Urban & Built-Up	2.2	2.5	0.3
Cropland	7.7	7.8	0.1
Pasture	2.0	1.0	-1.0
Forest	69.0	70.6	1.6
Federal	15.6	15.6	0
Other	3.1	2.0	-1.1
Total	100	100	
Area 2			
Water	0.6	0.7	0.1
Urban & Built-Up	3.9	4.4	0.5
Cropland	42.3	42.5	0.2
Pasture	7.9	4.9	-3.0
Forest	34.4	34.9	0.5
Federal	3.6	4.0	0.4
Other	7.3	8.5	1.2
Total	100	100	
Area 3			
Water	0.2	0.2	0
Urban & Built-Up	6.7	9.5	2.8
Cropland	65.8	61.7	-4.1
Pasture	5.2	5.2	0
Forest	18.2	17.0	-1.2
Federal	0	0	0
Other	3.9	6.5	2.6
Total	100	100	

Table 21. (Continued - Land Use Summary)

	Year 1958	1967	Percent Change
	Percent		
Area 4			
Water	0.2	0.4	0.2
Urban & Built-Up	14.4	24.4	10.0
Cropland	59.5	51.8	- 7.7
Pasture	7.4	4.9	- 2.5
Forest	9.4	7.8	- 1.6
Federal	0	0	0
Other	9.1	10.7	1.6
Total	100	100	
Area 5			
Water	0.2	0.5	0.3
Urban & Built-Up	5.5	7.1	1.6
Cropland	64.8	63.9	- 0.9
Pasture	14.2	11.7	- 2.5
Forest	9.3	9.0	- 0.3
Federal	0.5	.5	0
Other	6.4	7.3	.9
Total	100	100	
Basin			
Water	0.4	0.5	0.1
Urban & Built-Up	5.3	7.3	2.0
Cropland	44.4	43.0	- 1.4
Pasture	7.8	5.8	- 2.0
Forest	31.6	31.8	0.2
Federal	4.8	5.0	0.2
Other	5.9	6.6	0.7
Total	100	100	

1/ The land use categories are as defined in Soil and Water Conservation Needs Inventory, 1970.

Changes in the use of these land resources will occur. Table 22 illustrates the current land use and the projected changes in the acreages available for future specified uses within each subarea, under the assumption of no further project development. Continuous declines are projected to occur in the acreages available for crop and pasture production primarily because of urban and related development. The amount of land needed for urban expansion, which includes acreage for recreation and transportation facilities, is expected to increase by more than 38 percent between 1967 and 2020. The non-urban values within the table are not estimates of land requirements to meet projected needs. They represent an adjusted extension of the 1967 resource base.

Forested land is also projected to fluctuate in acreage. Subarea Two shows a 10 percent increase in forest acres between 1967 and 2020, primarily due to an increase in public forest land. Acreage in forest in Subarea Five is expected to increase between 1967 and 1980 and then decrease. This may be due to an initial increase in public forest land and then the encroachment of urban expansion upon private forest lands. The other subareas indicate a decrease in forest acres, primarily due to urban expansion.

Changes in the 1967 Basin land base projected to 2020 include a decrease of 5.8 percent in cropland, 5.5 percent in pasture and 1.4 percent in forest. On the other hand, a 38.3 percent increase is projected for urban areas, 6.9 percent for other and a 6.2 percent increase for water areas. The increase in water areas is due to projects under present construction and projected future increases in the number of private developments. The increase contains no projected water area increase due to water resource project development.

Table 22. Land Use Inventory, 1967 and Potential Acreage for 1980, 2000 and 2020, Southeast Wisconsin Rivers Basin and Subareas. 1/

	1967	1980	2000	2020
	1000 Acres			
Area 1				
Water 2/	16.2	16.5	16.8	17.1
Urban & Built-Up	94.4	95.3	96.9	99.0
Cropland	294.1	293.2	291.7	289.9
Pasture	38.9	37.7	37.5	37.3
Forest 3/	3,170.0	3,140.0	3,080.0	3,020.0
Other 4/	145.5	176.4	236.2	295.8
Total	3,759.1	3,759.1	3,759.1	3,759.1
Area 2				
Water	33.8	34.5	35.1	36.0
Urban & Built-Up	202.6	206.6	214.0	223.3
Cropland	1,942.9	1,939.2	1,932.5	1,924.2
Pasture	226.2	225.6	224.9	224.0
Forest	1,810.0	1,890.0	1,930.0	1,990.0
Other	358.2	277.8	230.5	176.2
Total	4,573.7	4,573.7	4,573.7	4,573.7
Area 3				
Water	3.2	3.3	3.4	3.5
Urban & Built-Up	167.1	171.1	178.5	187.8
Cropland	1,087.9	1,084.6	1,077.8	1,069.5
Pasture	91.6	91.2	90.5	89.6
Forest	310.0	290.0	250.0	210.0
Other	104.7	124.3	164.3	204.1
Total	1,764.5	1,764.5	1,764.5	1,764.5
Area 4				
Water	7.0	7.1	7.3	7.5
Urban & Built-Up	409.7	481.2	574.3	644.2
Cropland	871.5	806.1	721.5	657.8
Pasture	83.0	76.4	68.0	61.7
Forest	155.0	150.0	140.0	130.0
Other	155.7	161.1	169.8	180.7
Total	1,681.9	1,681.9	1,681.9	1,681.9

Table 22. (Continued)

	1967	1980	2000	2020
	1000 Acres			
Area 5				
Water	20.1	20.4	20.8	21.2
Urban & Built-Up	294.4	356.0	419.5	462.0
Cropland	2,637.7	2,586.0	2,532.6	2,497.0
Pasture	485.1	478.2	468.1	461.3
Forest	395.0	420.0	410.0	410.0
Other	297.0	331.7	278.3	277.8
Total	4,129.3	4,129.3	4,129.3	4,129.3
Basin				
Water	80.3	81.8	83.4	85.3
Urban & Built-Up	1,168.2	1,310.1	1,483.3	1,616.2
Cropland	6,834.0	6,709.2	6,556.2	6,438.3
Pasture	924.8	909.2	889.0	873.9
Forest	5,840.0	5,890.0	5,810.0	5,760.0
Other	1,061.1	1,008.1	1,086.5	1,134.7
Total	15,908.4	15,908.4	15,908.4	15,908.4

1/ The 1967 data are based upon county boundaries as reported in Soil and Water Conservation Needs Inventory, 1970.

2/ Water areas of more than 40 acres and rivers wider than 1/8 mile have been deducted from the total land area. The reported water acreage includes ponds and lakes of more than two acres and not more than 40 acres and streams that are less than 1/8 Mile wide.

3/ Includes forested Federal land, farmsteads, farm roads, fence and hedge rows, rural nonfarm residences, investment tracts, coastal dunes, marshes not used for grazing, strip mines, borrow and gravel pits, ditch banks, and idle, open, rural nonfarm land.

AGRICULTURAL PRODUCTION

Introduction

Estimates of the location of future agricultural production in the SEWRB are presented in this section. They are based on the assumptions broadly outlined in Chapter One, and made more explicit in the following discussion. Agricultural production has been evaluated within the framework of demand and supply. The demand for agricultural production from SEWRB is summarized again in Tables 23 and 24 . The supply side is based on projections based on assumptions made with respect to land resource availability, crop yields, production costs, livestock feeding efficiencies, and the development and distribution of new technological knowledge.

Technology

The adoption of new technology over the past three decades has accounted for a major portion of increased agricultural output. Widespread use of mechanization, hybrid seed, pesticides, heavier application of fertilizers, and improved strains of plants and livestock have enabled a steadily decreasing farm population to easily feed an increasing total population. Financial, educational and technical assistance programs designed to improve managerial abilities of the farmers and to encourage their adoption of new technology have also contributed. For the purposes of this study, production technology includes all output increasing factors other than water resource development and major land use changes.

Table 23. Total Production Demands by Crop, Southeast Wisconsin Rivers Basin, Projected to 1980, 2000 and 2020.

		1980	2000	2020
		----------1000 Units----------		
Wheat	Bu.	2,301.0	2,423.0	2,870.0
Oats	Bu.	82,381.0	72,072.0	70,266.0
Rye	Bu.	587.8	600.3	596.2
Barley	Bu.	1,817.1	1,913.8	2,042.3
Corn for grain	Bu.	122,572.0	164,131.0	222,030.0
Corn silage	Ton	7,991.0	10,079.0	13,387.0
Soybeans	Bu.	2,911.0	3,244.0	4,086.0
Potatoes	Cwt	5,525.4	7,651.8	10,758.0
Fruits	Ton	68.5	98.8	137.9
Comm. Veg.	Cwt	33,963.1	48,782.2	66,588.8
Comm. sod	Acres	15.5	15.5	15.5
Alf. Hay	Ton	5,093.0	4,989.0	4,630.0
Cl-Tim-Oth Hay	Ton	593.0	561.0	543.0
Cropland Past.	1/	758.0	825.0	1,000.0
Permanent Past.	1/	1,301.0	1,206.0	1,240.0

1/ Alfalfa hay equivalents (tons).

Table 24. Total Production of Livestock and Livestock Products, Southeast Wisconsin Rivers Basin, 1980, 2000 and 2020.

		1980	2000	2020
		1,000 Units		
Beef & Veal	(Lbs. Live Wt.)	773,500	993,000	1,259,000
Pork	(Lbs. Live Wt.)	607,200	789,820	1,020,740
Lamb & Mutton	(Lbs. Live Wt.)	6,160	7,040	8,250
Milk	(Lbs.)	10,008,090	12,167,618	15,484,510
Eggs	(No.)	700,007	851,895	1,043,407
Turkeys	(Lbs. Live Wt.)	10,052	13,802	19,085
Broilers	(Lbs. Live Wt.)	5,044	6,688	9,184
Chickens 1/	(Lbs. Live Wt.)	7,875	7,594	7,546

1/ Chickens = Laying flock salvage

Undoubtedly existing technology will be more widely adopted to increase crop yields and feeding efficiencies. It would be pure speculation to attempt to estimate the effects of future technological ideas or to estimate the speed at which technologies now under development will become available for general use. However, some important developments can be pointed out which are expected to be major contributors to increased production.

Plant varieties will be better adapted to variations in climate, more resistant to diseases and insects, more efficient in their use of water and nutrients, and more compact, with a higher proportion of fruit to foliage. Seeds that will germinate and grow under colder soil conditions are being developed, which should result in better use of early moisture and partial escape from hot, dry weather.

The development of additional hybrid varieties is in prospect. For example, the discovery of male sterility in certain small grains will make it possible to develop new hybrids under field conditions.

Closer row spacing and plant spacing within rows will result in better ground utilization and more plants per acre. Heavier application of high-analysis fertilizers is also expected to increase yields.

Widespread use of systemic insecticides and fungicides and specific herbicides will increase yields by reducing pest control problems.

The use of mechanical harvesting of many fruits and vegetables will become more widespread and will greatly reduce labor requirements. Closely associated, will be the development of varieties which are adapted to mechanical harvesting and designed to mature at a more uniform time.

Much greater use of performance testing in beef cattle and greater selection for rapid rates of gain will improve feeding efficiency. Artifical insemination will play an expanded role in making superior sires available in dairy, beef and swine production.

Trends toward specialization, increased farm size and scale of operation, and improvements in the organization and management of the farm business will continue and become increasingly important in meeting production objectives.

The projections of increased crop yields and improved feeding efficiencies for 1980, 2000 and 2020 are approximations of the technology that farmers will adopt based upon the assumed conditions. They do, however, represent the best available estimates and should be considered as feasible, provided that advances in technology and their adoption continue.

Crop Production

Crop Yield Projections Projected yields were developed for the major crops grown on each Soil Resource Group (SRG) within the Basin. These estimates, shown in Table 25 result from the review and adjustment by crop and soil specialists of future trends based upon historical information.

Table 25. Aggregate Yield Estimates Used in Southeast Wisconsin Rivers Basin Study, Current Normal and Projections to 1980, 2000 and 2020.

Crop	Area	CN	Yield/Acre 1980	2000	2020	Unit	Index (CN=100) 1980	2000	2020
Fruits	1	3.0	4.4	6.2	7.9	Tons	147	207	263
	2	3.0	4.4	6.2	7.9		147	207	263
	3	3.0	4.4	6.2	7.9		147	207	263
	4	2.9	4.2	6.0	7.5		145	207	259
	5	2.9	4.2	6.0	7.5		145	207	259
Vegetables	1	107	140	180	210	CWT	131	168	196
	2	107	140	180	210		131	168	196
	3	107	140	180	210		131	168	196
	4	106	135	175	205		127	165	193
	5	106	135	175	205		127	165	193
Potatoes	1	170	290	360	425	CWT	171	212	250
	2	170	290	360	425		171	212	250
	3	170	290	360	425		171	212	250
	4	180	330	420	500		183	233	278
	5	180	330	420	500		183	233	278
Barley	1	44.9	61	70	79	Bu.	136	156	176
	2	44.9	61	70	79		136	156	176
	3	44.9	61	70	79		136	156	176
	4	48.1	64	73	82		133	152	170
	5	48.1	64	73	82		133	152	170
Rye	1	14.5	20	26	28	Bu.	138	179	193
	2	14.5	20	26	28		138	179	193
	3	14.5	20	26	28		138	179	193
	4	21.1	35	36	37		166	171	175
	5	21.1	35	36	37		166	171	175

Table 25. (Continued)

Crop	Area	CN	Yield/Acre 1980	2000	2020	Unit	Index (CN=100) 1980	2000	2020
Wheat	1	25.2	32.3	38.8	45.1	Bu.	128	154	179
	2	36.7	47.0	56.6	65.7		128	154	179
	3	38.7	49.5	59.6	69.3		128	154	179
	4	39.1	50.1	60.3	70.1		128	154	179
	5	39.4	50.4	60.6	70.5		128	154	179
Oats	1	50.1	60.9	71.0	80.3	Bu.	122	142	160
	2	64.1	76.3	89.7	101.9		119	140	159
	3	62.8	77.6	89.5	100.3		124	142	160
	4	60.5	72.0	84.7	96.2		119	140	159
	5	67.1	79.9	94.0	106.7		119	140	159
Corn	1	51.8	64.8	76.7	87.1	Bu.	125	148	168
	2	73.4	92.1	108.9	123.6		125	148	168
	3	85.0	106.3	125.9	142.9		125	148	168
	4	86.5	108.1	128.3	145.7		125	148	168
	5	95.1	118.8	141.1	160.2		125	148	168
Silage	1	10.8	13.3	15.8	18.0	Tons	123	146	166
	2	11.5	15.4	18.3	20.8		134	160	181
	3	12.6	17.0	19.9	22.4		135	158	178
	4	12.3	16.4	19.5	22.2		133	158	180
	5	14.4	19.2	22.8	26.0		133	158	180
Soybeans	1	0	0	0	0	Bu.	0	0	0
	2	21.8	26.0	33.1	38.4		119	152	176
	3	22.9	27.2	34.7	40.2		119	152	176
	4	30.3	36.1	46.1	53.3		119	152	176
	5	27.4	32.6	41.6	48.2		119	152	176

Table 25. (Continued)

Crop	Area	CN	Yield/Acre 1980	2000	2020	Unit	Index (CN=100) 1980	2000	2020
Alfalfa Hay	1	1.9	3.0	3.4	3.9	Tons	158	179	205
	2	2.7	3.9	4.6	5.1		144	170	189
	3	2.8	4.1	4.8	5.3		146	171	189
	4	3.0	4.2	5.0	5.5		140	167	183
	5	3.2	4.6	5.5	6.1		144	172	191
Clover-Timothy-Other Hay	1	1.5	2.2	2.6	3.0	Tons	147	173	200
	2	2.0	2.9	3.5	4.0		145	175	200
	3	2.1	3.1	3.8	4.3		147	181	205
	4	2.3	3.4	4.1	4.7		148	178	204
	5	2.3	3.4	4.2	4.8		148	183	209
Cropland Pasture	1	1.3	1.9	2.3	2.5	Tons [1/]	146	176	192
	2	1.9	2.7	3.2	3.6		142	168	190
	3	1.9	2.7	3.3	3.6		142	173	190
	4	1.9	2.7	3.3	3.6		142	173	190
	5	2.4	3.3	4.0	4.4		138	166	183
Improved Permanent Pasture	1	1.2	1.7	2.1	2.3	Tons [1/]	142	175	192
	2	1.6	2.3	2.7	3.0		144	169	188
	3	1.8	2.5	3.0	3.3		144	166	183
	4	1.8	2.6	3.1	3.5		144	172	194
	5	2.0	2.8	3.3	3.7		140	165	185
Improvable Permanent Pasture	1	0.6	0.9	1.1	1.2	Tons [1/]	150	183	200
	2	0.8	1.2	1.4	1.6		150	175	200
	3	0.8	1.2	1.4	1.6		150	175	200
	4	0.9	1.3	1.6	1.8		144	178	200
	5	1.1	1.5	1.8	2.0		136	164	181

Table 25. (Continued)

Crop	Area	CN	Yield/Acre 1980	2000	2020	Unit	Index (CN=100) 1980	2000	2020
Non-improvable Permanent Pasture	1	0.4	0.5	0.6	.7	Tons 1/	125	150	175
	2	0.4	0.6	0.7	.8		150	175	200
	3	0.5	0.8	0.9	1.0		160	180	200
	4	0.6	0.8	1.0	1.1		133	166	183
	5	0.6	0.8	1.0	1.1		133	166	183

1/ All pasture yields are in alfalfa hay equivalents.

The yield projections are based on the combination of a long term historical trend and a recent trend reflecting more current practices. Generally, the recent trend was used to project to 1980 and the long term trend was used to project from 1980 to 2000 and 2020. The long term historical trend is based on state yield data from 1934 to 1959. The short term trend is based on county yield figures from 1953 to 1967. Both trends were obtained by a least squares delete regression in which historical yields were regressed against several variations of time. Variations due to weather were assumed to be offsetting in the long run and excluded as a variable.

The yields developed were reviewed jointly by soil and crop scientists from the University of Wisconsin and SCS specialists. Their knowledge of specific area conditions, current and possible future technological developments were used to adjust the initial estimates. Initial projections were made on a subarea basis. These subarea projections were converted to yield estimates for the various soil resource groups for production projections.

Production Costs. Production costs were developed for each subarea-crop-soil combination considered for production. Costs reflect current input price levels and relationships. All items of on-farm costs were included with the exception of charges for storage and land. The per acre production costs for each crop and soil were aggregates of three major categories of costs.

Fixed costs were developed to reflect costs which are associated with production on an acre basis regardless of yield. Labor and machinery costs for planting and cultivating were in this category.

The second category reflected differences due to yield variation; and included seed, fertilizer, lime, and harvest costs. Harvesting costs included the costs of equipment and labor needed to transport the crop to an on-farm storage facility. Off-farm transportation costs were not included. Fertilizer costs were established on a maintenance basis, i.e., application necessary to maintain the established yield and soil fertility level considering crop usage, runoff and soil leaching.

The third cost category included differential costs associated with the peculiarities of certain soils, such as slope, stoniness and wetness.

Projected Crop Production

The land resource base of the Basin is capable of producing the projected basin share of national food, feed and fiber requirements given the current state of resource development (Table 26). This table is based upon the projections reported in the following sectionsof this chapter. Projected yield increases and improved technology, as discussed previously, coupled with the use of cropland temporarily idled or in conservation use, contributes to meeting these requirements. However, the pressure on land reserves is greater, as projections are made further into the future. Shifts between subareas occur according to comparative advantage, resulting in substantial changes in idled acreage between the projection periods.

Table 26. Acreage Under Cultivation by Categories of Land Use Intensity, Southeast Wisconsin Rivers Basin, Current Normal and Projections to 1980, 2000 and 2020. 1/

	CN	1980	2000	2020
	1000 Acres			
Area 1				
Specialty Crops	7.1	6.2	7.3	9.0
Row Crops	25.7	13.6	8.7	6.0
Small Grains	28.9	18.9	30.5	53.6
Hay & Pasture	124.6	66.1	52.7	85.9
Idle Cropland	107.8	188.4	192.5	135.4
Total Cropland	294.1	293.2	291.7	289.9
Permanent Pasture	37.7	22.2	16.2	13.3
Idle Pastureland	0	15.5	21.3	24.0
Total Pastureland	37.7	37.7	37.5	37.3
Total	331.8	330.9	329.2	327.2
Area 2				
Specialty Crops	118.1	116.9	137.7	171.1
Row Crops	390.0	198.7	254.4	453.8
Small Grains	296.4	394.1	317.8	263.3
Hay & Pasture	727.1	406.2	333.0	277.7
Idle Cropland	411.3	823.3	889.6	758.3
Total Cropland	1,942.9	1,939.2	1,932.5	1,924.2
Permanent Pasture	226.0	142.9	99.3	75.8
Idle Pastureland	0	82.7	125.6	148.2
Total Pastureland	226.0	225.6	224.9	224.0
Total	2,168.9	2,164.9	2,157.4	2,148.2

Table 26. (Continued)

	CN	1980	2000	2020
		1000 Acres		
Area 3				
Specialty Crops	36.8	59.3	68.0	83.0
Row Crops	140.2	77.4	84.4	147.5
Small Grains	231.3	296.4	212.3	236.4
Hay & Pasture	495.3	348.1	353.9	323.1
Idle Cropland	184.6	303.4	359.2	279.5
Total Cropland	1,088.2	1,084.6	1,077.8	1,069.5
Permanent Pasture	91.7	64.3	45.5	39.0
Idle Pastureland	0	26.9	45.0	50.6
Total Pastureland	91.7	91.2	90.5	89.6
Total	1,179.8	1,175.8	1,168.4	1,159.1
Area 4				
Specialty Crops	48.8	38.6	34.7	32.3
Row Crops	285.0	189.9	228.1	288.2
Small Grains	159.2	211.9	148.6	128.1
Hay & Pasture	276.2	180.1	135.9	112.2
Idle Cropland	102.0	185.7	174.2	97.0
Total Cropland	871.2	806.2	721.5	657.8
Permanent Pasture	82.8	63.2	47.2	37.7
Idle Pastureland	0	13.2	20.8	24.0
Total Pastureland	82.8	76.4	68.0	61.7
Total	954.0	882.6	789.5	719.5

Table 26. (Continued)

	CN	1980	2000	2020
		1000 Acres		
Area 5				
Specialty Crops	67.4	74.8	78.3	81.8
Row Crops	930.4	972.4	1,001.4	1,010.1
Small Grains	337.2	257.7	257.2	204.3
Hay & Pasture	894.4	544.9	426.4	376.1
Idle Cropland	408.2	736.2	769.3	824.7
Total Cropland	2,637.6	2,586.0	2,532.6	2,497.0
Permanent Pasture	488.1	421.6	319.6	314.6
Idle Pastureland	0	56.6	148.5	146.7
Total Pastureland	488.1	478.2	468.1	461.3
Total	3,125.8	3,064.2	3,000.7	2,958.2
Basin				
Specialty Crops	278.0	295.8	325.8	377.1
Row Crops	1,771.3	1,451.9	1,577.0	1,905.7
Small Grains	1,053.1	1,179.0	966.5	885.6
Hay & Pasture	2,517.6	1,545.4	1,302.1	1,175.0
Idle Cropland	1,213.9	2,237.1	2,384.8	2,094.9
Total Cropland	6,833.9	6,709.2	6,556.2	6,438.3
Permanent Pasture	926.4	714.2	527.9	480.3
Idle Pastureland	0	195.0	361.1	393.6
Total Pastureland	926.4	909.2	889.0	873.9
Total	7,760.3	7,618.4	7,445.2	7,312.3

Table 26. (Footnotes)

1/ Specialty Crops: Fruits, Vegetables, Potatoes, Sod.
Row Crops: Corn, Corn Silage, Soybeans.
Small Grains: Wheat, Oats, Other Small Grains (Barley, Rye, etc.).
Hay & Pasture: Alfalfa, Clover-Timothy, Cropland Pasture.

Acreage and production projections for specific crops are given in Tables 27-32. In some subareas, acreages of certain crops decline between the base year and 1980 or 2000 and then increase. The reason is that initially yields increase faster than requirements in the initial years and then requirements increase faster than yields. Under the assumption of a cost minimization organization of agricultural resources, increasing amounts of cropland and pasture are projected to be available for other uses. As shown in Table 26, the trend for the entire Basin is for idled cropland to increase through 2000, and then decrease somewhat by 2020. This reflects the relatively faster rate of yield increases in the earlier periods, followed by relatively faster requirement increases by 2020. Care should be excercised in the interpretation of acreage in the idled cropland and pastureland categories. It is not a pool of land available in total for permanent conversion to non-agricultural uses. In 1970, it includes by definition land temporarily idle, land in conservation use only, and open land formerly cropped. While it is probable that some of this land will shift from agricultural to other uses, there will be a continuing requirement to maintain some for agricultural purposes. The reverse (increasing, then decreasing acreage) may also occur, indicating that changing yields and costs are altering the comparative advantage situation between subareas for a given crop.

Future crop production in Subarea One decreases except for oats and wheat (Table 27). The area also loses its comparative advantage in wheat production after 1980. The nature of the land resources, along with a shorter growing season, tend to limit the productiveness of this subarea.

Table 27. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Subarea 1, Current Normal and Projections for 1980, 2000, 2020.

Subarea 1 Crop	Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod.	Acres	Prod.	Acres	Prod.
					(1,000 Units)				
Wheat	Bu.	0.5	12.6	0.7	24.2	0.5	19.3	0.3	15.5
Oats	Bu.	27.5	1,327.7	16.8	1,048.9	28.8	2,097.9	52.2	4,195.8
Rye	Bu.	0.4	5.7	0.6	11.7	0.5	13.1	0.5	12.9
Barley	Bu.	0.5	21.4	0.8	50.0	0.7	48.7	0.6	50.4
Corn for grain	Bu.	4.6	306.0	2.2	188.2	1.3	150.5	0.9	120.4
Corn Silage	Ton	21.1	208.3	11.4	167.2	7.4	133.8	5.1	107.0
Soybeans	Bu.	0	0	0	0	0	0	0	0
Potatoes	CWT	4.2	705.3	1.5	435.0	1.7	612.0	2.1	892.5
Fruits	Ton	0.2	0.6	0.1	0.5	0.1	0.7	0.1	0.9
Comm. Vegetables	CWT	2.7	291.5	4.6	644.0	5.5	990.0	6.8	1,428.0
Commercial Sod	Acres[1/]	0	0	0	0	0	0	0	0
Alfalfa Hay	Ton	75.2	142.0	41.3	135.6	31.6	122.1	25.7	109.9
Cl-Tim-Oth-Hay	Ton	32.2	46.8	17.3	44.7	14.8	40.2	12.1	36.2
Cropland Pasture	Ton [2/]	17.2	22.7	7.5	15.9	6.3	15.9	48.1	134.7
Idle Cropland		107.8		188.4		192.5		135.4	
TOTAL CROPLAND		294.1		293.2		291.7		289.9	
Improved Pasture	Ton [2/]	8.2	9.9	4.9	9.2	3.5	8.3	2.9	7.4
Improvable Past.	Ton [2/]	27.2	16.8	16.0	16.7	11.8	15.1	9.7	13.5
N-Imprv. Pasture	Ton [2/]	2.3	0.8	1.3	0.8	0.9	0.7	0.7	0.6
Idle Pasture		0		15.5		21.3		24.0	
TOTAL PASTURE		37.7		37.7		37.5		37.3	
TOTAL AG. LAND		331.8		330.9		329.2		327.2	

1/ Sod is reported in acres only.
2/ Alfalfa hay equivalents (tons).

Table 28. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Subarea 2, Current Normal and Projections for 1980, 2000, 2020.

Subarea 2 Crop	Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod.	Acres	Prod.	Acres	Prod.
					(1,000 Units)				
Wheat	Bu.	4.8	172.8	3.1	137.8	5.2	275.6	9.1	551.1
Oats	Bu.	285.2	17,432.1	383.1	29,652.5	306.0	23,722.0	248.6	21,550.4
Rye	Bu.	1.1	15.9	3.3	66.3	2.8	72.0	2.4	65.8
Barley	Bu.	5.3	237.3	4.6	279.7	3.8	268.2	3.2	256.7
Corn for grain	Bu.	195.4	14,695.9	107.1	11,367.1	178.1	22,734.3	313.9	45,018.0
Corn Silage	Ton	186.3	2,131.0	87.2	1,704.1	70.2	1,778.9	129.6	3,557.9
Soybeans	Bu.	8.3	176.4	4.3	143.9	6.1	287.8	10.3	575.5
Potatoes	CWT	21.5	3,660.7	13.0	3,770.0	14.7	5,292.0	17.9	7,607.5
Fruits	Ton	3.7	11.2	0.5	2.1	0.6	3.7	0.6	4.7
Comm. Vegetables	CWT	92.4	9,881.2	102.9	14,406.0	121.9	21,942.0	152.1	31,941.0
Commercial Sod	Acres 1/	0.5		0.5		0.5		0.5	
Alfalfa Hay	Ton	472.7	1,270.5	285.0	1,216.7	212.2	1,095.1	170.3	985.6
Cl-Tim-Oth-Hay	Ton	87.6	169.6	49.1	162.5	42.6	173.6	44.0	156.2
Cropland Pasture	Ton 2/	166.8	317.8	72.2	221.0	78.2	239.5	63.4	239.5
Idle Cropland		411.3		823.3		889.6		758.3	
TOTAL CROPLAND		1,942.9		1,939.2		1,932.5		1,924.2	
Improved Pasture	Ton 2/	63.1	100.7	36.8	95.9	26.6	86.3	21.0	77.7
Improvable Past.	Ton 2/	124.4	102.6	86.7	118.7	60.9	106.8	46.6	96.2
N-Imprv. Pasture	Ton 2/	38.5	15.8	19.4	14.4	11.8	13.0	8.2	11.7
Idle Pasture		0		82.7		125.6		148.2	
TOTAL PASTURE		226.0		225.6		224.9		224.0	
TOTAL AG. LAND		2,168.9		2,164.9		2,157.4		2,148.2	

1/ Sod is reported in acres only.

2/ Alfalfa hay equivalents (tons).

Table 29. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Subarea 3, Current Normal and Projections for 1980, 2000, 2020.

Subarea 3 Crop	Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod.	Acres	Prod.	Acres	Prod.
					(1,000 Units)				
Wheat	Bu.	6.4	241.5	10.0	482.1	6.6	385.7	4.6	308.6
Oats	Bu.	222.4	13,749.4	277.2	21,504.6	198.0	17,203.9	225.1	20,447.3
Rye	Bu.	0.5	7.7	3.9	77.2	3.2	84.0	2.8	78.7
Barley	Bu.	2.0	88.3	5.3	325.7	4.5	312.8	3.9	307.2
Corn for grain	Bu.	38.7	3,213.1	23.5	2,607.8	39.1	5,215.5	68.2	10,431.0
Corn Silage	Ton	100.8	1,238.0	53.5	1,003.2	45.0	999.5	79.1	1,999.1
Soybeans	Bu.	0.7	16.2	0.4	13.3	0.3	10.7	0.2	8.5
Potatoes	CWT	0.7	118.8	0.8	232.0	0.9	324.0	1.0	425.0
Fruits	Ton	10.9	32.6	12.2	53.8	12.4	76.6	13.7	108.1
Comm. Vegetables	CWT	25.0	2,674.5	46.1	6,454.0	54.5	9,810.0	68.1	14,301.0
Commercial Sod	Acres 1/	0.2		0.2		0.2		0.2	
Alfalfa Hay	Ton	375.5	1,027.9	246.5	1,124.5	263.9	1,417.4	216.9	1,275.6
Cl-Tim-Oth-Hay	Ton 2/	37.8	79.1	40.3	149.0	28.7	134.1	35.0	158.8
Cropland Pasture	Ton 2/	82.0	158.5	61.3	190.5	61.3	238.9	71.2	295.1
Idle Cropland		184.6		303.4		359.2		279.5	
TOTAL CROPLAND		1,088.2		1,084.6		1,077.8		1,069.5	
Improved Pasture	Ton 2/	28.3	49.5	16.4	47.1	11.8	42.4	9.4	38.1
Improvable Past.	Ton 2/	52.2	43.4	41.6	59.1	29.6	53.2	26.3	53.7
N-Imprv. Pasture	Ton 2/	11.2	5.9	6.3	5.7	4.1	5.1	3.3	4.6
Idle Pasture		0		26.9		45.0		50.6	
TOTAL PASTURE		91.7		91.2		90.5		89.6	
TOTAL AG. LAND		1,179.8		1,175.8		1,168.4		1,159.1	

1/ Sod is reported in acres only.

2/ Alfalfa hay equivalents (tons).

Table 30. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Subarea 4, Current Normal and Projections for 1980, 2000, 2020.

Subarea 4 Crop	Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod. (1,000	Acres Units)	Prod.	Acres	Prod.
Wheat	Bu.	18.0	688.0	18.6	958.5	14.2	766.8	8.9	613.4
Oats	Bu.	127.0	7,294.9	181.3	13,197.1	124.2	10,557.6	110.3	8,446.1
Rye	Bu.	2.0	42.6	4.9	170.2	4.1	148.5	3.6	134.4
Barley	Bu.	12.2	587.5	7.1	457.1	6.1	442.2	5.3	437.5
Corn for grain	Bu.	171.7	14,704.4	102.1	13,225.8	152.6	22,962.5	207.3	34,594.0
Corn Silage	Ton	85.7	1,045.5	44.9	836.4	42.1	992.3	51.4	1,371.8
Soybeans	Bu.	27.6	866.0	42.9	1,658.7	33.4	1,658.7	29.5	1,658.7
Potatoes	CWT	6.7	1,197.0	2.3	757.4	2.3	982.8	2.6	1,282.5
Fruits	Ton	3.7	10.7	1.7	7.0	1.7	10.1	1.9	14.2
Comm. Vegetables	CWT	26.0	2,712.6	22.2	2,999.4	18.3	3,195.8	15.4	3,159.0
Commercial Sod	Acres 1/	12.4		12.4		12.4		12.4	
Alfalfa Hay	Ton	238.1	703.8	153.6	668.6	114.8	601.8	94.7	541.6
Cl-Tim-Oth-Hay	Ton	19.6	45.0	17.7	68.8	14.2	61.9	11.4	55.7
Cropland Pasture	Ton 2/	18.5	35.6	8.8	24.8	6.9	24.8	6.1	24.8
Idle Cropland		102.0		185.7		174.2		97.0	
TOTAL CROPLAND		871.2		806.2		721.5		657.8	
Improved Pasture	Ton 2/	32.5	59.8	20.4	56.8	15.2	51.1	12.2	46.0
Improvable Past.	Ton 2/	26.6	25.0	28.4	40.0	21.2	37.9	16.7	34.1
N-Imprv. Pasture	Ton 2/	23.7	14.2	14.4	13.4	10.8	12.1	8.8	10.9
Idle Pasture		0		13.2		20.8		24.0	
TOTAL PASTURE		82.8		76.4		68.0		61.7	
TOTAL AG. LAND		954.0		882.6		789.5		719.5	

1/ Sod is reported in acres only.

2/ Alfalfa hay equivalents (tons).

Table 31. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Subarea 5, Current Normal and Projections for 1980, 2000, 2020.

Subarea 5 Crop	Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod.	Acres	Prod.	Acres	Prod.
					(1,000 Units)				
Wheat	Bu.	9.1	349.2	17.1	698.4	16.6	975.6	19.5	1,381.4
Oats	Bu.	311.5	19,916.9	222.1	16,977.1	221.2	18,490.8	164.5	15,626.3
Rye	Bu.	3.5	74.6	7.5	262.4	7.9	282.7	8.2	304.4
Barley	Bu.	13.1	628.4	11.0	704.6	11.5	841.9	12.1	990.5
Corn for grain	Bu.	726.3	68,853.1	749.0	95,182.5	742.4	113,068.2	768.4	131,866.5
Corn Silage	Ton	166.2	2,366.8	193.5	4,280.0	232.1	6,174.5	208.5	6,351.2
Soybeans	Bu.	37.9	1,019.9	29.9	1,095.1	26.9	1,286.9	33.2	1,843.2
Potatoes	CWT	0.9	162.0	1.0	331.0	1.1	441.0	1.1	550.5
Fruits	Ton	1.1	3.1	1.2	5.1	1.3	7.7	1.3	10.0
Comm. Vegetables	CWT	62.9	662.1	70.1	9,459.7	73.4	12,844.5	76.9	15,759.8
Commercial Sod	Acres 1/	2.5		2.5		2.5		2.5	
Alfalfa Hay	Ton	633.8	2,050.0	395.9	1,947.5	298.3	1,752.7	260.5	1,717.4
Cl-Tim-Oth-Hay	Ton	75.4	176.9	49.2	168.0	36.8	151.2	36.2	136.1
Cropland Pasture	Ton 2/	185.2	438.8	99.8	305.9	91.3	305.9	79.4	305.9
Idle Cropland		408.2		736.2		769.3		824.7	
TOTAL CROPLAND		2,637.6		2,586.0		2,532.6		2,497.0	
Improved Pasture	Ton 2/	162.7	319.9	101.5	306.9	75.1	276.2	60.6	248.5
Improvable Past.	Ton 2/	322.9	346.2	318.4	515.4	243.4	496.7	253.1	595.8
N-Imprv. Pasture	Ton 2/	2.5	1.4	1.7	1.4	1.1	1.2	0.9	1.1
Idle Pasture		0		56.6		148.5		146.7	
TOTAL PASTURE		488.1		478.2		468.1		461.3	
TOTAL AG. LAND		3,125.8		3,064.2		3,000.7		2,958.2	

1/ Sod is reported in acres only.

2/ Alfalfa hay equivalents (tons).

Table 32. Crop Acreage and Production, Southeast Wisconsin Rivers Basin, Current Normal and Projections for 1980, 200, 2020.

Crop	Basin Total Prod. Unit	Current Normal		1980		2000		2020	
		Acres	Prod.	Acres	Prod.	Acres	Prod.	Acres	Prod.
					(1,000 Units)				
Wheat	Bu.	38.9	1,464.1	49.5	2,301.0	43.2	2,423.0	42.3	2,870.0
Oats	Bu.	973.6	59,721.0	1,080.5	82,381.0	878.2	72,072.0	800.7	70,266.0
Rye	Bu.	7.5	146.5	20.2	587.8	18.5	600.3	17.5	596.2
Barley	Bu.	33.1	1,562.9	28.8	1,817.1	26.6	1,913.8	25.1	2,042.3
Corn for grain	Bu.	1,136.7	101,772.5	983.8	122,572.0	1,113.6	164,131.0	1,358.8	222,030.0
Corn Silage	Ton	560.1	6,989.6	390.6	7,991.0	396.8	10,079.0	473.6	13,387.0
Soybeans	Bu.	74.5	2,078.5	77.6	2,911.0	66.6	3,244.0	73.3	4,086.0
Potatoes	CWT	34.0	5,843.8	18.6	5,525.4	20.7	7,651.8	24.7	10,758.0
Fruits	Ton	19.6	58.2	15.7	68.5	16.0	98.8	17.6	137.9
Comm. Vegetables	CWT	208.9	16,221.9	245.9	33,963.1	273.6	48,782.2	319.3	66,588.8
Commercial Sod	Acres [1/]	15.5		15.5		15.5		15.5	
Alfalfa Hay	Ton	1,795.3	5,194.2	1,122.2	5,093.0	920.8	4,989.0	768.1	4,630.0
Cl-Tim-Oth-Hay	Ton	252.6	517.3	173.6	593.0	137.2	561.0	138.7	543.0
Cropland Pasture	Ton [2/]	469.7	973.4	249.7	758.0	244.1	825.0	268.2	1,000.0
Idle Cropland		1,213.9		2,237.1		2,384.8		2,094.9	
TOTAL CROPLAND		6,833.9		6,709.2		6,556.2		6,438.3	
Improved Pasture	Ton [2/]	294.8	539.8	179.9	515.8	132.2	464.2	106.1	417.8
Improvable Past.	Ton [2/]	553.3	534.0	491.2	749.5	367.0	709.7	352.2	793.3
N-Imprv. Pasture	Ton [2/]	78.3	38.1	43.1	35.7	28.7	32.1	22.0	28.9
Idle Pasture		0		195.0		361.1		393.6	
TOTAL PASTURE		926.4		909.2		889.0		873.9	
TOTAL AG. LAND		7,760.3		7,618.4		7,445.2		7,312.3	

1/ Sod is reported in acres only.

2/ Alfalfa hay equivalents (tons).

Subarea Two substantially increases production of wheat, corn, corn silage and soybeans (Table 28). Oat production is increased somewhat.

Within Subarea Three, the large increase in production occurs in corn, corn silage, wheat and oats (Table 29). There is also some increase in cropland pasture and the hay crops.

Urbanization in Subarea Four, which includes Milwaukee and surrounding urban areas, is placing increasing pressure on land resources available for agricultural use (Table 30). However, the area does substantially increase its production of soybeans and corn. There is also an increased production of oats, corn silage and clover-timothy, although the actual acreages of these crops decrease.

Subarea Five shows increased production of wheat, corn, corn silage, and soybeans (Table 31). Again, increased yields play an important part, because acreages do not increase at a rate nearly equal to production.

Before the model was used to evaluate the relative profitability of various crop acreages and production among the subareas, the projected acreage for specialty crops was removed from the cropland base. This was done in recognition of the relative fixity of specialty crop operations. These specialty crop acreage projections were based upon a disaggregation of the Great Lakes Basin data and historical trend and production information. The projected acreage and production for these crops are presented in Table 33.

Table 33. Acreage and Production of Fruits and Vegetables, Southeast Wisconsin Rivers Basin, by Subarea, Current Normal and Projections to 1980, 2000 and 2020.

		Acreage					Production			
Crop	Subarea	CN	1980	2000	2020	Unit	CN	1980	2000	2020
Fruits	1	228	120	120	120	Tons	0.6	0.5	0.7	0.9
	2	3,717	480	600	600		11.2	2.1	3.7	4.7
	3	10,865	12,240	12,360	13,680		32.6	53.8	76.6	108.1
	4	3,712	1,670	1,680	1,890		10.7	7.0	10.1	14.2
	5	1,096	1,220	1,280	1,340		3.1	5.1	7.7	10.0
	Total	19,618	15,730	16,040	17,630		58.2	68.5	98.8	137.9
Vegetables	1	2,724	4,600	5,500	6,800	CWT	291.5	644.0	990.0	1,428.0
	2	92,348	102,900	121,900	152,100		9,881.2	14,406.0	21,942.0	31,941.0
	3	24,996	46,100	54,500	68,100		2,674.5	6,454.0	9,810.0	14,301.0
	4	25,977	22,220	18,260	15,410		2,712.6	2,999.4	3,195.8	3,159.0
	5	62,850	70,070	73,400	76,880		662.1	9,459.7	12,844.5	15,759.8
	Total	208,895	245,890	373,560	319,290		16,221.9	33,963.1	48,782.2	66,588.8
Potatoes	1	4,149	1,500	1,700	2,100	CWT	705.3	435.0	612.0	892.5
	2	21,534	13,000	14,700	17,900		3,660.7	3,770.0	5,292.0	7,607.5
	3	699	800	900	1,000		118.8	232.0	324.0	425.0
	4	6,650	2,300	2,340	2,570		1,197.0	757.4	982.8	1,282.5
	5	900	1,000	1,050	1,100		162.0	331.0	441.0	550.5
	Total	33,932	18,598	20,690	24,670		5,843.8	5,525.4	7,651.8	10,758.0

Table 33. (Continued)

Crop	Subarea	Acreage CN	Acreage 1980	Acreage 2000	Acreage 2020	Unit	Production CN	Production 1980	Production 2000	Production 2020
Sod 1/	1	0	0	0	0					
	2	490	490	490	490					
	3	192	190	190	190					
	4	12,352	12,350	12,350	12,350					
	5	2,500	2,500	2,500	2,500					
	Total	15,534	15,530	15,530	15,530					
Other Sm. Grain	1	870	1,400	1,200	1,100	Bu.	27.1	61.7	61.8	63.3
	2	6,382	7,900	6,600	5,600		253.2	346.0	340.2	322.5
	3	2,498	9,200	7,700	6,700		96.0	402.9	396.8	385.9
	4	14,235	12,000	10,180	8,970		630.1	627.3	590.7	571.9
	5	16,600	18,510	19,390	20,310		703.0	967.0	1,124.6	1,294.9
	Total	40,585	49,010	45,070	42,680		1,709.4	2,404.9	2,514.1	2,638.5

1/ Sod is reported in acres only.

Livestock Production and Numbers

Total basin production of livestock products was projected for 1980, 2000 and 2020 based upon the Great Lakes Basin index of production value adjusted to reflect local conditions. This index was then applied to the 1959 base year historical data to arrive at expected production for beef, lamb and mutton, pork and eggs. Projected milk and turkey production was factored from the Great Lakes Basin projections. The production of broilers was assessed by using the Great Lakes Basin production index. This index was then applied to 1964 data because the 1959 data did not yet reflect the large shift of broiler production to the southern states. The historical data consisted of livestock numbers so it was necessary to convert these into livestock product pounds, except for eggs and milk, The per animal conversion values were derived from "Projections in Livestock Feeding Efficiency 1980-2000-2020," Great Plains Agricultural Council Publication No. 31, May, 1968. However, the conversion value for beef was calculated from the "1970 Wisconsin Agricultural Statistics" as the average weight for all marketed animals sold for beef averaged over the years 1962 to 1969.

Basin production of livestock and livestock products is estimated to increase substantially by 2020, nearly double that of the base period. The only livestock product projected to decrease is chicken meat from the salvage oflaying flocks. Although egg production is expected to increase, the increased egg production per bird and the projected decrease in salvage weight per bird acts to actually decrease the pounds marketed.

Subarea Production Total production was then allocated to each of the subareas. Allocations among subareas were affected by such factors

as fixity of resources, climatic factors and the allocation of feed grains and roughages. Particularly, the relative immobility of roughages (hay, silage, pasture) caused a direct relationship between roughage production and the production of certain classes of livestock within a given subarea. Percentage distributions were calculated from historical data and others were calculated by using the projected distributions of feed grain production, roughage production, feed units within feed grain production, and feed units within roughage production.

A projected percentage distribution of livestock production was calculated giving consideration to all the aforementioned distributions. This was used to allocate livestock production to the five subareas as shown in Table 34.

Increased urbanization of Subarea Four (including Milwaukee and the adjoining metropolitan areas) implied a decreased emphasis upon agricultural production within that area. This is indicated by that subarea's decreasing relative percentage share of the Basin's livestock production.

Subarea Two, with its large acreage of roughage, is expected to produce an increasing share of the basin's milk and poultry requirements. Subarea Five is expected to increase its share of beef and feed grain production, but decrease its relative share of milk and poultry production.

Subarea Three is expected to produce an increased proportion of beef, pork, milk and turkeys. An increased share of pork and lamb and mutton is projected for Subarea One.

Table 34. Livestock and Livestock Product Production by Subarea, Southeast Wisconsin Rivers Basin, 1980, 2000 and 2020.

		Year			Year		
		1980	2000	2020	1980	2000	2020
		1,000 units			Percent		
Beef	(Lbs. Live Wt.)						
	Area 1	24,752	28,797	31,475	3.2	2.9	2.5
	2	184,093	238,320	305,937	23.8	24.0	24.3
	3	133,042	176,754	230,397	17.2	17.8	18.3
	4	85,085	103,272	123,382	11.0	10.4	9.8
	5	346,528	445,857	567,809	44.8	44.9	45.1
	Basin	773,500	993,000	1,259,000			
Pork	(Lbs. Live Wt.)						
	Area 1	3,643	5,528	8,166	0.6	0.7	0.8
	2	122,047	169,021	241,915	20.1	21.4	23.7
	3	57,684	83,721	127,592	9.5	10.6	12.5
	4	40,075	47,390	53,079	6.6	6.0	5.2
	5	383,750	484,160	589,988	63.2	61.3	57.8
	Basin	607,200	789,820	1,020,740			
Lamb & Mutton	(Lbs. Live Wt.)						
	Area 1	105	127	148	1.7	1.8	1.8
	2	1,343	1,577	1,988	21.8	22.4	24.1
	3	357	317	264	5.8	4.5	3.2
	4	659	690	760	10.7	9.8	9.2
	5	3,696	4,329	5,090	60.0	61.5	61.7
	Basin	6,160	7,040	8,250			
Milk	(Lbs.)						
	Area 1	250,202	279,855	309,690	2.5	2.3	2.0
	2	2,872,321	3,723,291	5,032,466	28.7	30.6	32.5
	3	2,001,618	2,567,367	3,282,716	20.0	21.1	21.2
	4	1,000,811	1,155,925	1,393,606	10.0	9.5	9.0
	5	3,883,138	4,441,180	5,466,032	38.8	36.5	35.3
	Basin	10,008,090	12,167,618	15,484,510			

Table 34. (Continued)

		Year			Year		
		1980	2000	2020	1980	2000	2020
		1,000 units			Percent		
Turkeys	(Lbs. Live Wt.)						
	Area 1	0	0	0	0	0	0
	2	5,408	7,743	11,317	53.8	56.1	59.3
	3	1,437	2,153	3,263	14.3	15.6	17.1
	4	443	373	210	4.4	2.7	1.1
	5	2,764	3,533	4,294	27.5	25.6	22.5
	Basin	10,052	13,802	19,085			
Eggs	(Number)						
	Area 1	14,000	17,038	20,868	2.0	2.0	2.0
	2	177,802	214,678	262,938	25.4	25.2	25.2
	3	86,101	103,931	127,296	12.3	12.2	12.2
	4	133,001	160,156	188,857	19.0	18.8	18.1
	5	289,103	356,092	443,447	41.3	41.8	42.5
	Basin	700,007	851,895	1,043,407			
Broilers	(Lbs. Live Wt.)						
	Area 1	0	0	0	0	0	0
	2	1,831	3,217	5,161	36.3	48.1	56.2
	3	383	502	680	7.6	7.5	7.4
	4	394	341	303	7.8	5.1	3.3
	5	2,436	2,628	3,040	48.3	39.3	33.1
	Basin	5,044	6,688	9,184			
Laying Chickens	(Lbs. Live Wt.)						
	Area 1	157	152	151	2.0	2.0	2.0
	2	2,000	1,914	1,901	25.4	25.2	25.2
	3	969	926	921	12.3	12.2	12.2
	4	1,496	1,428	1,366	19.0	18.8	18.1
	5	3,252	3,174	3,207	41.3	41.8	42.5
	Basin	7,874	7,594	7,546	100	100	100

Livestock Numbers

Projections of livestock numbers are provided in Table 35. These numbers are based on the livestock production projections presented in Table 34. Numbers and production values do not necessarily move in the same proportion due to changes in efficiency and weights. For example, the number of dairy cows does not increase at the same rate as the increase in milk because milk production per cow also increases.

The allocated livestock production was converted into livestock numbers utilizing the conversion values previously noted, except for beef. The sources of beef are dairy cow salvage, veal, dairy beef calves, dairy beef steers and heifers, feed-lot beef, and cow-calf beef operations. The allocation of dairy cows determines the allocation of beef from veal, dairy cow salvage, dairy beef calves and a portion of dairy steers and heifers.

The beef from dairy cow salvage was estimated under the assumptions that the average longevity is eight years and the average weight at slaughter is 1,100 pounds. The number of milk cows per area divided by eight gives the number of dairy cows slaughtered for beef in each planning area. This number times 1,100 pounds yields the contribution of dairy cow salvage to the total beef demand for each area.

The beef from veal production was estimated assuming an 85 percent calf crop from dairy cows, considering conception rate and mortality. It was also assumed that 23 percent of these calves were raised for veal and marketed at an average weight of 250 pounds. The product of 19.5 percent (85% X 23%) and the number of milk cows gives the numbers and allocation of veal calves. This number for each area times 250 pounds equals the contribution of veal production to the total beef demand for each subarea.

Table 35. Distribution of Livestock Numbers by Subarea, Southeast Wisconsin Rivers Basin, 1980, 2000 and 2020.

	1980	2000	2020	Unit	Per Animal Conversion 1980	2000	2020
	----------1,000----------						
Hogs							
Area 1	15.8	24.0	35.5				
2	530.6	735.0	1,051.8				
3	250.8	364.0	554.7				
4	174.2	206.0	230.7				
5	1,668.4	2,105.0	2,565.1	Lbs.	230	230	230
Basin	2,639.8	3,434.0	4,437.8				
Sheep							
Area 1	1.0	1.2	1.3				
2	12.2	14.3	18.0				
3	3.2	2.9	2.4				
4	5.9	6.2	6.9				
5	33.6	39.3	46.3	Lbs.	110	110	110
Basin	55.9	63.9	74.9				
Milk Cows							
Area 1	23.1	23.2	25.3				
2	265.5	308.3	411.9				
3	185.0	212.6	268.7				
4	92.5	95.7	114.0				
5	358.9	367.7	447.4	Lbs.	10,818	12,077	12,218
Basin	925.0	1,007.5	1,267.3	of Milk			
Laying Chickens							
Area 1	58.3	64.3	74.5				
2	740.8	810.1	939.0				
3	358.8	392.1	454.6				
4	554.2	604.3	674.5				
5	1,204.6	1,343.7	1,583.7	No.	240	265	280
Basin	2,916.7	3.214.5	3.726.3	of Eggs			

Table 35. (Continued)

	1980	2000	2020	Unit	Per Animal Conversion 1980	2000	2020
	----------1,000----------						
Turkeys							
Area 1	0	0	0				
2	360.5	516.2	754.4				
3	95.8	143.5	217.5				
4	29.5	24.9	14.0				
5	184.0	235.5	286.3	Lbs.	15	15	15
Basin	669.8	920.1	1,272.2				
Broilers							
Area 1	0	0	0				
2	457.7	804.2	1,290.2				
3	95.8	125.5	170.0				
4	98.5	85.2	75.7				
5	609.0	657.0	760.0	Lbs.	4	4	4
Basin	1,261.0	1,671.9	2,295.9				
Dairy Cows Sold for Beef							
Area 1	2.9	2.9	3.2				
2	33.2	38.5	51.5				
3	23.1	26.6	33.6				
4	11.6	12.0	14.2				
5	44.9	46.0	55.9	Lbs.	1,100	1,100	1,100
Basin	115.7	126.0	158.4				
Veal Calves							
Area 1	4.5	4.5	4.9				
2	51.8	60.1	80.3				
3	36.1	41.5	52.4				
4	18.0	18.7	22.2				
5	70.0	71.7	87.3	Lbs.	250	250	250
Basin	180.4	196.5	247.1				

Table 35. (Continued)

	1980	2000	2020	Unit	Per Animal Conversion 1980	2000	2020
	----------1,000----------						
Dairy Beef Calves							
Area 1	7.9	7.9	8.6				
2	90.3	104.8	140.0				
3	62.9	72.3	91.4				
4	31.4	32.5	38.8				
5	122.0	125.0	152.1	Lbs.	300	300	300
Basin	314.5	342.5	430.9				
Dairy Beef Steers & Heifers							
Area 1	4.3	4.4	5.2				
2	70.5	79.2	102.8				
3	48.6	54.8	69.1				
4	58.7	63.1	78.5				
5	132.4	141.0	175.3	Lbs.	750	750	750
Basin	314.5	342.5	430.9				
Cow-Calf Beef							
Area 1	36.1	34.2	28.6				
2	134.2	164.1	155.1				
3	106.0	135.6	142.5				
4	11.8	12.9	6.4	Weaning			
5	117.5	106.7	61.8	Weight			
Basin	405.6	453.5	394.4	Lbs.	367	439	497
Feed-Lot Beef							
Area 1	2.4	6.6	11.4				
2	9.0	31.7	61.9				
3	7.1	26.2	56.8				
4	16.6	39.8	53.3	Weight			
5	166.1	329.1	518.0	Added			
Basin	201.2	433.4	701.4	Lbs.	606	569	534

The assumptions for dairy beef were an 85 percent calf crop from dairy cows and that 40 percent of these calves were raised for beef. The product of 34 percent (85% X 40%) and the number of milk cows yields the number of dairy beef young and the allocation as to where calved. This is the distribution of dairy beef calves. Information was obtained that indicated that the average market weight of a dairy beef animal was approximately 1,050 pounds and that nearly 30 percent of this weight was gained at the same location where the animal was calved. Therefore, the distribution of dairy beef calf numbers times 300 pounds gives the contribution of dairy beef calves to the total beef demand within each subarea.

However, all dairy beef are not fed to market weight at the location where calved. A Wisconsin Statistical Reporting Service (SRS) survey in 1969 and subsequent information indicated the following:

Area	Percent of Cattle Fed	Percent Fed Out in Subarea Where Calved
1	1	30
2	18	40
3	9	50
4	25	35
5	47	35

Taking the "percent fed out where calved" times the allocated number of dairy beef calves yields the number of steers and heifers fed to market weight in that subarea of those that were calved in that subarea. The rest were assumed to be "shipped" to other locations. The sum (over all subareas) of all those that were designated as "shipped" were allocated to the subareas according to the percentage distribution of "percent of cattle fed." For

each subarea, the total number of dairy steers and heifers is the sum of those fed out in the subarea and those allocated to the subarea from the total "shipped." This gives the final distribution of dairy beef steers and heifers. These numbers times 750 pounds (1,050 Lb. market wt - 300 Lb. dairy beef calves) gives the contribution to the total beef demand.

Summing the production from dairy cow salvage, veal, and dairy steers and heifers gives the total dairy beef production for each subarea. The dairy beef production was subtracted from total beef production to arrive at total beef from feed-lot and cow-calf operations within each subarea. The assumptions used to allocate this production are shown in Figure 4.

The total beef production from non-dairy sources was allocated to feed-lot and cow-calf beef based on the percentages in Figure 4. This beef was then converted to animal numbers using the average weights also presented in Figure 4.

Applying the results of these procedures to the subarea beef production, obtains the livestock numbers for each source of beef within each subarea.

Salvage from laying chickens was calculated from the number of laying chickens which, in turn, was calculated from the number of eggs. Information obtained from poultry extension indicated that for a laying flock, one could expect 10 percent mortality per year and a turnover rate of about 18 months or 75 percent per year. Other information from the same source indicated a salvage weight by projection year of 1980 - 4.0 lbs., 2000 - 3.5 lbs., and 2020 - 3.0 lbs.

Figure 4. Data Used to Allocate Feed-Lot and Cow-Calf Beef Between Subareas and Per Animal Contribution to Production. 1/

	1980	2000	2020
Lbs. average weight added in feed-lot	606	569	534
Lbs. average weaning weight, cow-calf 2/	367	439	497

Percent of feed-lot beef Subareas 1, 2 and 3	10	20	30
Percent of feed-lot beef Subareas 4 and 5	70	80	90

1/ Source: Unpublished data from Great Lakes Basin Study and "Projections in Livestock Feeding Efficiency 1980-2000-2020," Great Plains Agricultural Council Publication No. 31, May, 1968.

2/ Includes mortality and beef cow salvage.

Value of Production The value of agricultural production is projected to increase 55.5 percent between 1980 and 2020 (Tables 36, 37, 38, 39, 40 and 41). The subarea-increases range from 38 percent in Subareas One and Four to 80 percent in Subarea Two. The proportion of total production value from livestock and livestock products is consistently greater than that from crops. The proportion of Basin production value from livestock products is shown to increase slightly over the projection period.

Subarea One is projected to produce less than two percent of the total Basin value of production and this share may decrease over time. Subareas Two and Three indicate production of an increasing share of the total Basin value. Subareas Four and Five are expected to produce decreasing shares, although Subarea Five's share, the largest, may be between 41 and 46 percent.

Table 36. Value of Production, Subarea One, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Subarea 1					
		Adjusted Normal		Value	
Product	Unit	Price 1/	1980	2000	2020
			----------	$1000	----------
Corn	Bu.	$1.061	200	160	128
Oats	Bu.	.63	661	1,322	2,643
Wheat	Bu.	1.235	30	24	19
Soybeans	Bu.	2.303	0	0	0
Hay	Ton	18.92	3,411	3,070	2,763
Corn Silage	Ton	8.02	1,341	1,073	858
Vegetables	CWT	3.566	2,296	3,530	5,092
Barley	Bu.	1.044	52	51	53
Rye	Bu.	1.08	13	14	14
Potatoes	CWT	2.227	969	1,363	1,988
Noncitrus Fruit	Ton	93.90	47	66	85
Total Crop			9,019	10,671	13,641
Percent of Subarea Total			39.4	40.0	43.1
Beef	Lbs.	.184	4,549	5,293	5,785
Pork	Lbs.	.15	548	832	1,229
Lamb	Lbs.	.145	15	18	21
Chickens	Lbs.	.141	22	21	21
Turkeys	Lbs.	.21	0	0	0
Eggs	No.	.025	348	423	518
Milk	Lbs.	.034	8,412	9,409	10,412
Broilers	Lbs.	.141	0	0	0
Total Livestock			13,895		
Percent of Subarea Total			60.6	60.0	56.9
Total Subarea 1			22,913	26,668	31,628
Percent of Basin Total			2.0	1.9	1.8

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

Table 37. Value of Production, Subarea Two, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Subarea 2

Product	Unit	Adjusted Normal Price 1/	Value 1980	2000	2020
			---------$1000----------		
Corn	Bu.	1.061	12,056	24,113	47,747
Oats	Bu.	.63	18,681	14,945	13,577
Wheat	Bu.	1.235	170	340	681
Soybeans	Bu.	2.303	331	663	1,325
Hay	Ton	18.92	26,096	24,003	21,602
Corn Silage	Ton	8.02	13,667	14,267	28,534
Vegetables	CWT	3.566	51,365	78,234	113,886
Barley	Bu.	1.044	292	280	268
Rye	Bu.	1.08	72	78	71
Potatoes	CWT	2.227	8,396	11,785	16,942
Noncitrus Fruit	Ton	93.90	197	347	441
Total Crop			131,323	169,055	245,075
Percent of Subarea Total			45.9	45.6	47.5
Beef	Lbs.	.184	33,836	43,803	56,231
Pork	Lbs.	.15	18,366	25,434	36,403
Lamb	Lbs.	.145	194	228	288
Chickens	Lbs.	.141	282	270	268
Turkeys	Lbs.	.21	1,136	1,626	2,377
Eggs	No.	.025	4,415	5,331	6,530
Milk	Lbs.	.034	96,567	125,177	169,192
Broilers	Lbs.	.141	*	*	1
Total Livestock			154,798	201,871	271,289
Percent of Subarea Total			54.1	54.4	52.5
Total Subarea 2			286,120	370,926	516,364
Percent of Basin Total			25.1	26.4	29.1

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

* Less than $500

Table 38. Value of Production, Subarea Three, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Subarea 3					
		Adjusted Normal		Value	
Product	Unit	Price 1/	1980	2000	2020
			---------$1000----------		
Corn	Bu.	1.061	2,766	5,532	11,063
Oats	Bu.	.63	13,548	10,838	12,882
Wheat	Bu.	1.235	595	476	381
Soybeans	Bu.	2.303	31	25	20
Hay	Ton	18.92	24,095	29,353	27,139
Corn Silage	Ton	8.02	8,046	8,016	16,033
Vegetables	CWT	3.566	23,012	34,978	50,990
Barley	Bu.	1.044	340	327	321
Rye	Bu.	1.08	83	91	85
Potatoes	CWT	2.227	517	722	946
Noncitrus Fruit	Ton	93.90	5,052	7,193	10,151
Total Crop			78,084	97,550	130,010
Percent of Subarea Total			43.1	42.0	42.5
Beef	Lbs.	.184	24,453	32,487	42,347
Pork	Lbs.	.15	8,680	12,598	19,200
Lamb	Lbs.	.145	52	46	38
Chickens	Lbs.	.141	137	131	130
Turkeys	Lbs.	.21	302	452	685
Eggs	No.	.025	2,138	2,581	3,161
Milk	Lbs.	.034	67,294	86,315	110,365
Broilers	Lbs.	.141	*	*	*
Total Livestock			103,056	134,610	175,927
Percent of Subarea Total			56.9	58.0	57.5
Total Subarea 3			181,141	232,160	305,937
Percent of Basin Total			15.9	16.5	17.2

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

* Less than $500

Table 39. Value of Production, Subarea Four, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Subarea 4					
Product	Unit	Adjusted Normal Price 1/	Value 1980	2000	2020
			---------$1000----------		
Corn	Bu.	1.061	14,028	24,355	36,691
Oats	Bu.	.582	7,681	6,145	4,916
Wheat	Bu.	1.274	1,221	977	782
Soybeans	Bu.	2.523	4,186	4,186	4,186
Hay	Ton	22.00	16,223	14,601	13,141
Corn Silage	Ton	8.02	6,708	7,958	11,002
Vegetables	CWT	3.566	10,694	11,395	11,263
Barley	Bu.	.826	377	365	361
Rye	Bu.	1.03	175	153	138
Potatoes	CWT	2.975	2,253	2,924	3,815
Noncitrus Fruit	Ton	93.90	657	948	1,333
Total Crop			64,204	74,005	87,629
Percent of Subarea Total			49.3	48.8	48.7
Beef	Lbs.	.222	18,889	22,926	27,391
Pork	Lbs.	.155	6,213	7,347	8,229
Lamb	Lbs.	.151	100	104	115
Chickens	Lbs.	.141	212	202	193
Turkeys	Lbs.	.21	93	78	44
Eggs	No.	.023	3,090	3,721	4,388
Milk	Lbs.	.037	37,340	43,128	51,995
Broilers	Lbs.	.141	*	*	*
Total Livestock			65,937	77,507	92,356
Percent of Subarea Total			50.7	51.2	51.3
Total Subarea 4			130,141	151,512	179,984
Percent of Basin Total			11.4	10.8	10.1

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

* Less than $500

Table 40. Value of Production, Subarea Five, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Subarea 5 Product	Unit	Adjusted Normal Price 1/	Value 1980	2000	2020
			---------$1000----------		
Corn	Bu.	1.061	100,953	119,923	139,861
Oats	Bu.	.582	9,881	10,762	9,095
Wheat	Bu.	1.274	890	1,243	1,760
Soybeans	Bu.	2.523	2,763	3,247	4,651
Hay	Ton	22.00	46,542	41,887	40,777
Corn Silage	Ton	8.02	34,326	46,593	50,937
Vegetables	CWT	3.566	33,729	45,797	56,192
Barley	Bu.	.826	582	695	818
Rye	Bu.	1.03	270	291	314
Potatoes	CWT	2.975	985	1,312	1,638
Noncitrus Fruit	Ton	93.90	479	723	939
Total Crop			231,399	272,474	306,980
Percent of Subarea Total			44.4	43.8	41.4
Beef	Lbs.	.222	76,929	98,980	126,054
Pork	Lbs.	.155	59,497	75,064	91,472
Lamb	Lbs.	.151	559	654	769
Chickens	Lbs.	.141	460	449	453
Turkeys	Lbs.	.21	580	742	902
Eggs	No.	.023	6,717	8,273	10,303
Milk	Lbs.	.037	144,880	165,700	203,938
Broilers	Lbs.	.141	*	*	*
Total Livestock			289,622	349,864	433,891
Percent of Subarea Total			55.6	56.2	58.6
Total Subarea 5			521,021	622,338	740,871
Percent of Basin Total			45.7	44.3	41.7

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

* Less than $500

Table 41. Value of Production, Southeast Wisconsin Rivers Basin, Projections to 1980, 2000 and 2020.

Basin Product	Unit	Adjusted Normal Price 1/	Value 1980	2000	2020
			----------$1000----------		
Corn	Bu.	1.061	130,003	174,082	235,491
Oats	Bu.	.612	50,452	44,011	43,112
Wheat	Bu.	1.263	2,906	3,060	3,622
Soybeans	Bu.	2.512	7,311	8,120	10,182
Hay	Ton	20.465	116,367	112,914	105,422
Corn Silage	Ton	8.02	64,088	77,907	107,364
Vegetables	CWT	3.565	121,095	173,933	237,422
Barley	Bu.	.904	1,643	1,717	1,820
Rye	Bu.	1.043	613	627	622
Potatoes	CWT	2.374	13,119	18,106	25,329
Noncitrus Fruit	Ton	93.90	6,432	9,277	12,949
Total Crop			514,029	623,756	783,335
Percent of Basin Total			45.0	44.4	44.1
Beef	Lbs.	.205	158,657	203,490	257,808
Pork	Lbs.	.154	93,304	121,276	156,533
Lamb	Lbs.	.149	920	1,051	1,232
Chickens	Lbs.	.141	1,113	1,073	1,066
Turkeys	Lbs.	.21	2,111	2,898	4,008
Eggs	No.	.024	16,708	20,329	24,900
Milk	Lbs.	.035	354,494	429,729	545,901
Broilers	Lbs.	.141	1	1	1
Total Livestock			627,307	779,848	991,449
Percent of Basin Total			55.0	55.6	55.9
Total Basin			1,141,336	1,403,604	1,774,784

1/ Adjusted Normal Price - Price estimates derived from long-term trend lines which removes short-term abnormalities such as fluctuations in weather. They are also adjusted to reduce the influence of Government programs.

* Less than $500

WATER REQUIREMENTS

The Basin water requirements were calculated for the three projection periods in order to assist in the identification of potential water supply problems. These problems could occur not only in terms of quantity of water, but also in terms of quality and availability related to a specific water use. The following data presents the projected requirements and consumtive use of the requirement levels.

Rural Water Requirements

Rural farm water use generally depends on the human and livestock population and the particular crops grown in an area. The type of farming carried out in a region, coupled with the general climatic factors, influence water use. This operates particularly through the evaporation and transpiration ratios. For example, livestock requirements are generally less in the more northern areas.

The rural nonfarm water use is based primarily upon human population and associated uses. It does not vary as much with climate as does the livestock and farm domestic uses.

As shown in Table 42, total rural water requirements are projected to reach 60,531 million gallons by 2020 or 166 million gallons per day. This is nearly 50 percent greater than the projection of 118 million gallons per day in 1980. The subareas with larger populations, as would be expected, have larger water requirements. Subareas two and five have the largest

Table 42. Rural Water Requirements and Consumption, Southeast Wisconsin Rivers Basin. Projections to 1980, 2000 and 2020.

Subarea	Rural Farm Domestic 1/	Rural Farm Spray Water 2/	Rural Farm Livestock 3/	Total Rural Farm	Rural NonFarm 4/	Total Rural
	----------1000 Gal.----------					
1 Requirements						
1980	94,785	2,196	738,285	835,266	1,266,915	2,102,181
2000	60,848	1,769	774,385	837,002	1,269,835	2,106,837
2020	47,553	1,474	776,432	825,459	1,245,563	2,071,022
Consumption						
1980	23,696	2,196	664,456	690,348	190,037	880,385
2000	15,212	1,769	696,946	713,927	190,475	904,402
2020	11,888	1,474	698,789	712,151	186,834	898,985
2 Requirements						
1980	1,126,359	24,223	5,840,361	6,990,943	4,223,050	11,213,993
2000	818,301	23,627	7,536,356	8,378,284	5,355,280	13,733,564
2020	771,638	28,015	9,503,794	10,303,447	6,301,725	16,605,172
Consumption						
1980	281,590	24,223	5,256,325	5,562,138	633,478	6,195,616
2000	204,575	23,267	6,782,720	7,010,562	803,292	7,813,854
2020	192,910	28,015	8,553,415	8,774,340	945,259	9,719,599
3 Requirements						
1980	776,755	13,660	4,091,515	4,881,930	2,545,693	7,427,623
2000	578,943	13,431	5,292,261	5,884,635	3,226,965	9,111,600
2020	520,208	14,017	6,552,554	7,086,779	3,805,125	10,891,904
Consumption						
1980	194,189	13,660	3,682,363	3,890,212	381,854	4,272,066
2000	144,736	13,431	4,763,035	4,921,202	484,045	5,405,247
2020	130,052	14,017	5,897,299	6,041,368	570,769	6,612,137

Table 42. (Continued)

Subarea	Rural Farm Domestic 1/	Rural Farm Spray Water 2/	Rural Farm Livestock 3/	Total Rural Farm	Rural NonFarm 4/	Total Rural
	1000 Gal.					
4 Requirements						
1980	372,141	11,271	1,853,960	2,237,372	4,263,383	6,500,755
2000	259,359	10,821	2,186,170	2,456,350	4,670,540	7,126,890
2020	220,267	11,608	2,526,182	2,758,057	5,017,838	7,775,895
Consumption						
1980	93,035	11,271	1,668,564	1,772,870	639,507	2,412,377
2000	64,840	10,821	1,967,553	2,043,214	700,581	2,743,795
2020	55,067	11,608	2,273,564	2,340,239	752,676	3,092,915
5 Requirements						
1980	1,402,233	44,972	8,686,641	10,133,846	5,629,943	15,763,789
2000	991,797	42,495	10,414,963	11,449,255	7,767,200	19,216,455
2020	836,210	40,261	12,315,700	13,192,531	9,994,613	23,187,144
Consumption						
1980	350,558	44,972	7,817,977	8,213,507	844,491	9,057,998
2000	247,947	42,495	9,373,467	9,663,911	1,165,080	10,828,991
2020	209,052	40,261	11,084,130	11,333,443	1,499,192	12,832,635
Basin Requirements						
1980	3,772,273	96,322	21,210,762	25,079,357	17,928,984	43,008,341
2000	2,709,248	92,143	26,204,135	29,005,526	22,289,820	51,295,346
2020	2,395,876	95,375	31,674,662	34,166,273	26,364,864	60,531,137
Consumption						
1980	943,068	96,322	19,089,685	20,129,075	2,689,367	22,818,442
2000	677,310	92,143	23,583,721	24,353,176	3,343,473	27,696,649
2020	598,969	95,375	28,507,197	29,201,541	3,954,730	33,156,271

1/ Rural Farm Domestic - Farm home and human water requirements.
2/ Rural Farm Spray Water - Spray water required for insect and weed control.
3/ Rural Farm Livestock - Water required for all livestock uses.
4/ Rural Nonfarm - Rural nonfarm home and human water requirements.

water requirements, based upon the fact that these subareas have the largest rural farm populations and biggest livestock concentrations.

Consumptive use is defined as that part of the water withdrawn that is no longer available because of loss either through evaporation or transpiration or otherwise removed from the Basin's water environment. Table 42 also shows the estimated consumption levels in conjunction with the Basin's requirements. Total rural consumption for the Basin is projected to reach 33,157 million gallons or nearly 91 million gallons per day by 2020. The consumptive use rates were: rural nonfarm - 15 percent of requirements, rural farm domestic - 25 percent, livestock - 90 percent, and spray water - 100 percent. These are the same as were used for the Great Lakes Basin.

The rural water use budgets, which illustrate the factors used in calculating these rural water requirements, are shown in Tables 43, 44 and 45.

Rural Farm Domestic Rural farm domestic water requirements are projected to decrease in accordance with the decrease in farm population. This holds true for each of the subareas.

Spray Water The spray water requirements are shown to decrease in Subareas One and Five. This is due to the decreasing share of the Basin crop production in Subarea One and the shift in the type of crops produced in Subarea Five. Subarea Two is projected to have the greatest increase in spray water requirements because of its increasing share of crop production and its increased production of crops that require spray water.

Table 43. Basin Rural Domestic, Crop, and Livestock Basic Water Use Budget, 1980.

Type of Use	Unit Size	Period of Use	Unit Use
Rural Domestic			
Family water use, Farm & Non-farm	1 person	365 days	65 gal/day/capita
Car and truck washing	Rural Residence		200 gal/capita
Lawn and garden	Rural Residence	10 hrs.	300 gal/hr.
Swimming pool	(1 per 100 families)		16,830 gal + make up
Spray Water for Disease, Insect, and Weed Control			
Vegetables and Potatoes			100 gal/acre
Fruit Trees			75 gal/acre
Small fruit			150 gal/acre
Corn			30 gal/acre
Soybeans, Hay, & Dry beans			20 gal/acre
Livestock			
Cows, milk		300 days	Maintenance 14 gal/day + 1 gal/3 lbs milk
Dry cows		65 days	14 gal/day
Young stock		365 days	12 gal/day
Veal calves		90 days	12 gal/day/animal
Dairy beef calves		150 days	12 gal/day/animal
Dairy beef steers & heifers		365 days	12 gal/day/animal
Dairy cleaning & sanitizing		365 days	3.5 gal/day/cow
Liquid manure handling		365 days	0.1 gal/cow
Sows		365 days	4 gal/day
Pigs		165 days	2 gal/day
Wallow		150 days	1 gal/day/pig
Cleaning & sanitizing		180 days	1 gal/day/pig
Fogging and cooling		150 days	0.5 gal/day/pig
Laying flock		365 days	6 gal/day/100 hens
Egg washing		365 days	1 gal/day/100 hens
Cleaning & sanitizing		10 days	4 gal/day/100 hens
Broilers		84 days	0.02 gal/day/bird
Beef cows & replacements		365 days	14 gal/day
Cattle and calves		365 days	12 gal/day
Feedlot beef		265 days	12 gal/day/animal
Cow-calf beef		205 days	12 gal/day/animal
Turkeys		140 days	10 gal/day/100
Breeding flock		365 days	12 gal/day/100
Cleaning & sanitizing			5% of tot. water consump.
Sheep and lambs		180 days	1.5 gal/day
Ewe flock		365 days	2 gal/day
Mortality of Young Stock*			
Dairy	4%	180 days	6 gal/day
Pigs	10%	82 days	1 gal/day
Chickens	8%	180 days	2.5 gal/day/100
Beef	4%	180 days	6 gal/day
Turkeys	8%	70 days	6 gal/day/100
Sheep	10%	90 days	0.8 gal/day

*Approximately ½ of the young stock requirement for ½ the period of use.

Adapted from: Water Systems Analysis to Meet Changing Conditions, Agricultural Engineering Information Series 152, 1965, and Farm Water Systems Planning Guide, Agricultural Engineering Information Series 181, 1967, Michigan State University; Private Water Systems, Midwest Plan Service -14, Iowa State University, 1968 and Dairy Farmstead Water Use, paper by Elmer E. Jones, USDA-ARS, Beltsville, Md., June 1964, in consultation with Ernest Kidder, Agricultural Engineer; Michigan State University; Melville Palmer, Agricultural Engineer, Ohio State University; Donald Keech, Sanitary Engineer, Michigan Department of Public Health, and Arthur Lied, Regional Supervisor, Michigan Department of Agriculture.

Table 44. Basin Rural Domestic, Crop, and Livestock Basic Water Use Budget, 2000.

Type of Use	Unit Size	Period of Use	Unit Use
Rural Domestic			
Family water use, Farm & Non-farm	1 person	365 days	70 gal/day
Car and truck washing	Rural Residence		200 gal
Lawn and garden	Rural Residence	20 hrs.	300 gal/hr.
Swimming pool	(1 per 60 families)		30,000 gal + make up
Spray Water for Disease, Insect, and Weed Control			
Vegetables and Potatoes			80 gal/acre
Fruit Trees			50 gal/acre
Small fruit			120 gal/acre
Corn			30 gal/acre
Soybeans, Hay, & Dry beans			20 gal/acre
Livestock			
Cows, milk		300 days	Maintenance 14 gal/day + 1 gal/3 lbs milk
Dry cows		65 days	14 gal/day
Young stock		365 days	12 gal/day
Veal calves		90 days	12 gal/day/animal
Dairy beef calves		150 days	12 gal/day/animal
Dairy beef steers & heifers		365 days	12 gal/day/animal
Dairy cleaning & sanitizing		365 days	5 gal/day/cow
Liquid manure handling		365 days	0.5 gal/cow
Sows		365 days	4 gal/day
Pigs		155 days	2 gal/day
Wallow		150 days	0.5 gal/day/pig
Cleaning & sanitizing		180 days	2 gal/day/pig
Fogging and cooling		150 days	1 gal/day/pig
Laying flock		365 days	6 gal/day/100 hens
Egg washing		365 days	1 gal/day/100 hens
Cleaning & sanitizing		15 days	4 gal/day/100 hens
Broilers		84 days	0.02 gal/day/bird
Beef cows & replacements		365 days	14 gal/day
Cattle and calves		365 days	12 gal/day
Feedlot beef		265 days	12 gal/day/animal
Cow-calf beef		205 days	12 gal/day/animal
Turkeys		125 days	12/gal/day/100
Breeding flock		365 days	14 gal/day/100
Cleaning & sanitizing			5% of tot. water consump.
Sheep and lambs		150 days	2 gal/day
Ewe flock		365 days	2 gal/day
Mortality of Young Stock*			
Dairy	3%	180 days	6 gal/day
Pigs	7%	78 days	1 gal/day
Chickens	6%	180 days	3 gal/day/100
Beef	3%	180 days	6 gal/day
Turkeys	6%	62 days	6.5 gal/day/100
Sheep	7%	75 days	1 gal/day

*Approximately ½ of the young stock requirement for ½ the period of use.

Adapted from: Water Systems Analysis to Meet Changing Conditions, Agricultural Engineering Information Series 152, 1965, and Farm Water Systems Planning Guide, Agricultural Engineering Information Series 181, 1967, Michigan State University; Private Water Systems, Midwest Plan Service -14, Iowa State University, 1968 and Dairy Farmstead Water Use, paper by Elmer E. Jones, USDA-ARS, Beltsville, Md., June, 1964, in consultation with Ernest Kidder, Agricultural Engineer; Michigan State University; Melville Palmer, Agricultural Engineer, Ohio State University; Donald Keech, Sanitary Engineer, Michigan Department of Public Health, and Arthur Lied, Regional Supervisor, Michigan Department of Agriculture.

Table 45. Basin Rural Domestic, Crop, and Livestock Basic Water Use Budget, 2020.

Type of Use	Unit Size	Period of Use	Unit Use
Rural Domestic			
Family water use, Farm & Non-farm	1 person	365 days	75 gal/day
Car and truck washing	Rural Residence		200 gal
Lawn and garden	Rural Residence	20 hrs.	300 gal/hr.
Swimming pool	(1 per 40 families)		30,000 gal + make up
Spray Water for Disease, Insect, and Weed Control			
Vegetables and Potatoes			60 gal/acre
Fruit trees			30 gal/acre
Small fruit			100 gal/acre
Corn			30 gal/acre
Soybeans, Hay, & Dry beans			20 gal/acre
Livestock			
Cows, milk		300 days	Maintenance 14 gal/day + 1 gal/3 lbs milk
Dry cows		65 days	14 gal/day
Young stock		365 days	12 gal/day
Veal calves		90 days	12 gal/day/animal
Dairy beef calves		150 days	12 gal/day/animal
Dairy beef steers & heifers		365 days	12 gal/day/animal
Dairy cleaning & sanitizing		365 days	5 gal/day/cow
Liquid manure handling		365 days	0.5 gal/cow
Sows		365 days	4 gal/day
Pigs		150 days	2 gal/day
Wallow		150 days	0.5 gal/day/pig
Cleaning & sanitizing		180 days	2 gal/day/pig
Fogging and cooling		150 days	1 gal/day/pig
Laying flock		365 days	6 gal/day/100 hens
Egg washing		365 days	1 gal/day/100 hens
Cleaning & sanitizing		15 days	4 gal/day/100 hens
Broilers		84 days	0.02 gal/day
Beef cows & replacements		365 days	14 gal/day
Cattle and calves		365 days	12 gal/day
Feedlot beef		265 days	12 gal/day/animal
Cow-calf beef		205 days	12 gal/day/animal
Turkeys		125 days	12 gal/day/100
Breeding flock		365 days	14 gal/day/100
Cleaning & sanitizing		-	-
Sheep and lambs		140 days	2 gal/day
Ewe flock		365 days	2 gal/day
Mortality of Young Stock*			
Dairy	3%	180 days	6 gal/day
Pigs	5%	75 days	1 gal/day
Chickens	5%	180 days	3 gal/day/100
Beef	3%	180 days	6 gal/day
Turkeys	5%	62 days	6.5 gal/day/100
Sheep	5%	70 days	1 gal/day

*Approximately ½ of the young stock requirement for ½ the period of use.

Adapted from: Water Systems Analysis to Meet Changing Conditions, Agricultural Engineering Information Series 152, 1965, and Farm Water Systems Planning Guide, Agricultural Engineering Information Series 181, 1967, Michigan State University; Private Water Systems, Midwest Plan Service -14, Iowa State University, 1968 and Dairy Farmstead Water Use, paper by Elmer E. Jones, USDA-ARS, Beltsville, Md., June, 1964, in consultation with Ernest Kidder, Agricultural Engineer; Michigan State University; Melville Palmer, Agricultural Engineer, Ohio State University; Donald Keech, Sanitary Engineer, Michigan Department of Public Health, and Arthur Lied, Regional Supervisor, Michigan Department of Agriculture.

Livestock Water Due to the increase in livestock production, each subarea is shown to have increased livestock water requirements. Subarea Two has the greatest increase in requirements, as it is also projected to have the largest increase in livestock production.

Rural Nonfarm The rural nonfarm water requirements are shown to increase throughout the Basin except for Subarea One. As in the case of farm domestic requirements, rural nonfarm requirements are tied directly to the population and the rural nonfarm population is projected to decrease in Subarea One.

Irrigation Water Requirements At the present, irrigation within the Basin includes a portion of each specialty crop plus a small amount of field crops (corn, soybeans and alfalfa). Irrigation of field crops is declining and by 1980 no major irrigation of these field crops is anticipated (Table 46). On the other hand, irrigation of specialty crops is expected to increase substantially. By the year 2020, it is estimated that 100 percent of the sod, nearly 94 percent of potatoes, 67 percent of the vegetables and 19 percent of the fruit will be irrigated.

Irrigation water requirements within the Basin are projected to increase 287 percent by 2020, from the present 12,315 million gallons to 47,697 million gallons in 2020 (Table 47). The increase in acres irrigated is from 61,272 acres to 255,460 acres. Most of this irrigation will occur on potatoes and vegetable crops. Consumptive use of water is high for irrigation, 100 percent of requirements.

There are many factors which operate singly or in combination that influence the amount of irrigation water required. The effects of these factors are not necessarily constant and may vary with locality and may fluctuate at one locality.

Table 46. Irrigated Acres, Southeast Wisconsin Rivers Basin, Current Normal and Projections to 1980, 2000 and 2020.

Crop	Subarea	Year				Percent Irrigated of Total Specified Crop			
		CN	1980	2000	2020	CN	1980	2000	2020
		Acres				Percent			
Potatoes	1	141	100	230	570	3.4	6.8	13.6	27.2
	2	7,737	9,330	14,700	17,900	35.9	71.8	100	100
	3	309	710	900	1,000	44.2	88.4	100	100
	4	899	620	1,260	2,570	13.5	27.0	54.0	100
	5	900	1,000	1,050	1,100	100	100	100	100
	Basin	9,986	11,760	18,140	23,140	29.4	63.2	87.7	93.8
Fruits	1	0	0	0	0	0	0	0	0
	2	407	110	260	530	11.0	22.0	44.0	88.0
	3	131	290	590	1,860	1.2	2.4	4.8	13.6
	4	245	220	440	1,000	6.6	13.2	26.4	52.8
	5	0	0	0	0	0	0	0	0
	Basin	783	620	1,290	3,390	4.0	3.9	8.0	19.2
Vegetables	1	200	670	1,610	3,970	7.3	14.6	29.2	58.4
	2	24,025	53,510	121,900	152,100	26.0	52.0	100	100
	3	738	2,770	6,540	16,340	3.0	6.0	12.0	24.0
	4	2,288	3,910	6,430	10,850	8.8	17.6	35.2	70.4
	5	3,104	6,870	14,390	30,140	4.9	9.8	19.6	39.2
	Basin	30,355	67,730	150,870	213,400	14.5	27.5	55.2	66.8
Sod	1	0	0	0	0	0	0	0	0
	2	490	490	490	490	100	100	100	100
	3	192	190	190	190	100	100	100	100
	4	9,150	12,350	12,350	12,350	74.1	100	100	100
	5	1,433	2,500	2,500	2,500	57.3	100	100	100
	Basin	11,265	15,530	15,530	15,530	72.5	100	100	100
Corn, Small Grain & Hay	1	0							
	2	8,144							
	3	0							
	4	82							
	5	657							
	Basin	8,883	0	0	0				
Total	1	341	770	1,840	4,540				
	2	40,803	63,440	137,350	171,020				
	3	1,370	3,960	8,220	19,390				
	4	12,664	17,100	20,480	26,770				
	5	6,094	10,370	17,940	33,740				
	Basin	61,272	95,640	185,830	255,460				

Table 47. Irrigation Water Requirements, Southeast Wisconsin Rivers Basin, Current Normal and Projections to 1980, 2000 and 2020.

Crop	Subarea	CN	1980	2000	2020
		1000 Gal.			
Potatoes					
	1	45,938	32,580	74,934	185,706
	2	2,520,715	3,039,714	4,789,260	5,831,820
	3	100,672	231,318	293,220	325,800
	4	292,894	201,996	410,508	837,306
	5	293,220	325,800	342,090	358,380
	Basin	3,253,439	3,831,408	5,910,012	7,539,012
Fruit					
	1	0	0	0	0
	2	63,531	16,290	39,096	81,450
	3	20,525	45,612	91,224	289,962
	4	38,444	35,838	68,418	156,384
	5	0	0	0	0
	Basin	122,500	97,740	198,738	527,796
Vegetables					
	1	34,535	117,288	276,930	684,180
	2	4,148,411	9,239,688	21,049,938	26,262,738
	3	127,388	478,926	1,130,526	2,821,428
	4	395,195	674,406	1,110,978	1,873,350
	5	535,941	1,185,912	2,485,854	5,203,026
	Basin	5,241,470	11,696,220	26,054,226	36,844,722
Sod					
	1	0	0	0	0
	2	87,966	87,966	87,966	87,966
	3	34,535	35,838	35,838	35,838
	4	1,639,751	2,212,182	2,212,182	2,212,182
	5	256,730	449,604	449,604	449,604
	Basin	2,018,982	2,785,590	2,785,590	2,785,590
Corn, Small Grain and Hay	1	0			
	2	1,539,079			
	3	0			
	4	15,638			
	5	124,130			
	Basin	1,678,847	0	0	0
Total					
	1	80,473	149,868	351,864	869,886
	2	8,359,702	12,383,658	25,966,260	32,263,974
	3	283,120	791,694	1,550,808	3,473,028
	4	2,381,922	3,124,422	3,802,086	5,079,222
	5	1,210,021	1,961,316	3,277,548	6,011,010
	Basin	12,315,238	18,410,958	34,948,566	47,697,120

The amount and rate of precipitation is one important factor. Precipitation may come ranging from a series of light showers to heavy storms. Light showers may result in most of the moisture being lost to evaporation from the surface of plant foliage and land. A large portion of precipitation from a heavy storm may be lost by surface runoff. Also, precipitation may come shortly after an irrigation application and, therefore, be lost by surface runoff. An area that appears to have adequate precipitation may require irrigation to meet the consumptive needs of the crop because of a combination or any one of these conditions.

Other factors that influence the amount of irrigation water required are temperature and its distribution, growing season, amount of sunlight, humidity, wind movements, advection, and the stage of plant growth. Soil fertility and the quality of water may have a small degree of influence on the consumptive use of the plant.

APPENDIX I

SOILS DESCRIPTION

LIST OF APPENDIX TABLES

APPENDIX I

Soils Description

This appendix was included in the report in order to furnish more detailed information on the soils and soil characteristics within the Southeast Wisconsin Rivers Basin. The appendix will include a description of each Soil Resource Group (SRG) contained within the Basin, a definition of the class description added to each SRG, a distribution of the SRG's by subarea, and a description of the broader category of soil management groups (SMG).

Soil Resource Groups

Definition -- Soil Resource Groups (SRG) are land capability units grouped according to similarities of soil texture and management problems, such as wetness, flood hazard, and droughtness. They have similar cropping patterns, yield characteristics, responses to fertilizers, management, and land treatment measures (e.g., flood protection and drainage).

SRG	Description
1	Deep, well and moderately well drained medium textured upland and terrace soils. Moderately slow to moderate permeability with high available moisture capacity. Slopes are predominately 0-2 percent, and erosion is slight. Illinois includes somewhat poorly drained soils.
2	Well and moderately well drained, medium to moderately coarse textured alluvial soils. (Some coarser textured soils included). Moderate to moderately slow permeability and high available moisture capacity. Fine textured horizons may occur throughout the lower portion of the profile. Slopes are predominately 0-6 percent, and erosion is slight.
3	Well to moderately well drained, moderately fine and medium textured soils, with moderate to moderately slow permeability and high available moisture capacity.

Slopes are predominately 2-6 percent and erosion is slight to moderate. Includes 4-7 percent slopes in Illinois.

4 Well and moderately well drained upland or terrace soils with moderately coarse to medium textured surface soils and medium to moderately fine textured subsoil. Some soils have coarse textured substrata. Permeability is moderate and available moisture capacity is moderate. Slopes are predominately 0-6 percent and erosion is slight to moderate. Some soils are included which have fragipans.

5 Well and moderately well drained fine textured soils. Permeability is slow with high available moisture capacity. Slopes are predominately 0-6 percent and erosion is slight to moderate. Illinois includes some somewhat poorly drained soils on slopes.

6 Somewhat excessively to moderately well drained, moderately coarse and medium textured soils overlying bedrock at a depth of 20 to 40 inches. Permeability of the solum is moderate to rapid, available moisture capacity is low. Slopes are predominately 0-6 percent and erosion is slight to moderate. (Some Wisconsin soils are underlain by sand and gravel at a depth of 20 to 40 inches).

7 Well and moderately well drained, coarse and moderately coarse textured soils, some underlain by sand and gravel and some coarse textured soils underlain by bedrock at 20 to 40 inches. Permeability is rapid, available moisture capacity is low. Slopes are predominately 0-6 percent and erosion is slight to moderate.

8 Excessively to moderately well drained, coarse textured soils with rapid permeability and low available moisture capacity. All slopes and erosion classes are included. Included are soils underlain by loams and clays at depths or 42 to 66 inches and moderately coarse textured soils on slopes greater than 12 percent and shallow soils (less than 20 inches to bedrock).

9 Well and moderately well drained soils with moderately fine textured surface soils and fine textured subsoils. Permeability is slow with high available moisture capacity. Slopes are predominately 7-18 percent and erosion is slight to moderate. Some Illinois soils include slopes ranging from 2-4 percent which are severely eroded.

10 Well and moderately well drained, moderately fine and medium textured soils and eroded moderately coarse textured soils; subsoils are firm to very firm. Some soils have coarse textured substrata. Permeability is moderate to moderately slow and available moisture capacity is moderate to high. Slopes are predominately 7-18 percent and erosion is slight to moderate.

11 Well and moderately well drained upland or terrace soils with moderately coarse to medium textured surface soils and medium to moderately fine textured subsoil. Some soils with coarse textured substrata and some with fragipans are included. Permeability is moderate and available moisture capacity is moderate. Slopes are predominately 7-18 percent and erosion is slight to moderate.

12 Well and moderately well drained, coarse and moderately coarse textured soils, some underlain by sand and gravel. Permeability is rapid, available moisture capacity is low. Slopes are predominately 7-18 percent and erosion is slight to moderate.

13 Well drained, fine, moderately fine, medium and moderately coarse textured soils with slopes ranging from 18-25 percent. Permeability is slow to rapid and available moisture capacity is low to high. Severely eroded soils from Illinois with slopes ranging from 6-12 percent are included. Also included are soils with bedrock or gravel at a depth of 20 to 40 inches.

14 Well drained, fine, moderately fine, medium and moderately coarse textured soils with slopes exceeding 25 percent and some soils with severe erosion. Permeability is slow to rapid and available moisture capacity is low to high. Soils are included with bedrock or gravel at a depth of 20 to 40 inches.

15 Beach sands, acid organic soils, shallow lakes and swamps, gravel pits, spagnum peat, marshy peat land, fresh water marsh, rockland, rough stony land, mountain land, beach and river wash.

16 Somewhat poorly and poorly drained, moderately fine and medium textured soils. Permeability is moderate to moderately slow and available moisture capacity is high to very high. Slopes are predominately 0-8 percent and erosion is slight. Some soils are underlain with gravel, sand or bedrock at a depth of 20 to 40 inches.

17 Somewhat poorly and poorly drained, moderately coarse textured soils. Permeability is moderate to moderately rapid and available water holding capacity is moderate. Erosion is slight to moderate and slopes are predominately 0-6 percent.

18 Somewhat poorly and poorly drained, moderately fine to fine textured surface soils and fine textured subsoils. They have slow permeability and high available moisture capacity. Slopes are predominately 0-6 percent.

19 Somewhat poorly, poorly and very poorly drained, moderately coarse and coarse textured soils. Some are underlain by sand and gravel and some are underlain by fine textured material at 20 to 40 inches. Some medium and moderately coarse textured soils with a fragipan are included. Permeability is moderate and available moisture capacity is medium to low. Slopes are predominately 0-6 percent and erosion is slight to moderate.

20 Somewhat poorly and poorly drained, moderately fine to moderately coarse textured (includes coarse texture in Michigan) alluvial and depressional soils frequently flooded. Permeability is moderate and available moisture capacity is medium. Slopes are predominately 0-6 percent and erosion is slight.

21 Very poorly drained organic soils (muck and peats). Some soils included are underlain by mineral materials at depths of 20 to 40 inches.

22 Somewhat poorly to very poorly drained coarse to fine textured, very stony or rocky soils. All slopes and erosion.

23 Well to moderately well drained, coarse to fine textured very stony or rocky soils. All slopes and erosion.

Class Description A third digit was added to the previous two digit SRG classification to identify management situations. The meaning of the third digit, referred to as class, and its association with the two digit SRG code is specified below and in Table AI-1. The combination of the two components forms a more definitive three digit SRG code.

Class Descriptions

Class 1	Soils naturally having no drainage or flooding problems.
Class 2	Soils naturally wet, but adequately drained artifically.
Class 3	Soils naturally wet, no drainage measures in place. It also includes protected floodplains with drainage problems.
Class 4	Non-flood soils naturally wet, with some drainage. It also includes protected floodplains with incomplete drainage measures.
Class 5	Protected floodplain soils.
Class 6	Unprotected floodplain soils.
Class 7	Unprotected floodplains having drainage problems.
Class 8	Acreage with combined flooding and drainage problems.

Table AI-1. SRG Code and Associated Class Description, Southeast Wisconsin Rivers Basin, Current Normal.

SRG	Class	SRG	Class	SRG	Class
1	1	12	1	19	2
2	5	13	1	19	3
2	6	14	1	19	4
3	1	15	1	19	8
3	3	16	2	20	3
3	4	16	3	20	4
4	1	16	4	20	5
5	1	16	8	20	6
5	3	17	2	20	7
5	4	17	3	21	2
6	1	17	4	21	3
7	1	17	8	21	4
8	1	18	2	21	8
9	1	18	3	22	2
10	1	18	4	22	3
11	1	18	8	22	4
				23	1

SRG Distribution Table AI-2 illustrates the distribution of SRG's within the Basin by subarea, by three digit classification. The table presents the acres of each SRG, two digit plus class description, for each subarea. These SRG acreages include only cropland and permanent pasture.

Soil Management Groups

In an attempt to create a soil mapping unit capable of being applied to a broad land area such as a single watershed, soil management groups

Table AI-2. Distribution of Current Normal Cropland and Permanent Pasture Acreage by Soil Resource Group, Southeast Wisconsin Rivers Basin Subareas.

SRG	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Basin
11	2,398	76,776	4,239	99,666	220,766	403,845
25	0	220	204	0	59,223	59,647
26	0	0	0	0	56,502	56,502
31	123,872	516,610	246,924	261,466	1,125,110	2,273,982
33	3,856	15,189	12,092	0	0	31,137
34	87	34,784	9,856	0	0	44,727
41	32,135	109,837	7,639	19,074	14,163	182,848
51	1,857	218,257	256,276	107,747	15,019	599,156
53	224	27,920	13,964	0	0	42,108
54	0	26,775	76,719	0	175	103,669
61	1,233	11,962	72,178	8,119	85,390	178,882
71	31,453	212,731	4,935	8,757	41,526	299,402
81	6,163	46,687	0	0	3,726	56,576
91	0	45,813	52,154	20,258	29,830	148,055
101	60,276	161,768	41,895	70,319	908,054	1,242,312
111	1,060	41,160	0	10,597	4,527	57,344
121	10,692	74,986	45,921	18,786	14,209	164,594
131	3,203	18,732	11,785	14,837	90,989	139,546
141	610	19,805	5,736	5,241	18,299	49,691
151	1,043	4,000	0	0	0	5,043
162	4,565	46,404	144,023	109,955	140,301	445,248
163	10,818	103,471	48,983	43,669	42,652	249,593
164	16,483	190,867	79,665	84,584	66,368	437,967
168	550	38,463	34,835	17,482	66,339	157,669
172	2,176	0	0	0	0	2,176
173	487	0	0	0	0	487
174	301	0	0	0	0	301
178	86	0	0	0	0	86
182	0	2,700	0	0	0	2,700
183	0	351	131	0	0	482
184	0	8,193	0	0	0	8,193
188	721	1,840	0	0	0	2,561
192	3,546	2,638	399	1,875	3,813	12,271
193	2,439	25,620	900	623	1,753	31,335
194	5,841	16,763	100	1,184	6,814	30,702
198	134	5,863	0	246	7,855	14,098
203	0	220	0	0	3,841	4,061
204	300	500	0	0	2,299	3,099
205	0	0	0	0	8,750	8,750
207	0	4,500	0	0	5,330	9,830
212	906	6,826	1,939	16,337	30,693	56,701
213	1,928	9,945	2,182	9,298	2,400	25,753
214	354	30,582	1,745	13,088	20,951	66,720
218	0	632	2,430	10,944	27,906	41,912
222	0	800	0	0	221	1,021
223	0	7,450	0	0	0	7,450
224	0	250	0	0	0	250
TOTAL	331,798	2,168,892	1,179,848	954,152	3,125,793	7,760,483

(SMG) were created. These soil groupings were based on similar management practices and location. Utilization of an SMG allows statements to be made about a broader land area than would be possible by looking only at SRG's. Fifteen SMG's were created within the Basin and Table AI-3 illustrates the SRG's contained within each SMG within the Basin.

The remainder of this appendix contains a soil description of each of the SMG units.

Table AI-3. Relative Distribution of SRG's Within Each Mapped SMG, Southeast Wisconsin Rivers Basin.

SMG	SRG	Percent	SMG	SRG	Percent	SMG	SRG	Percent
1	1	80	6	4	65	11	2	80
	16	20		16	20		20	20
				7	15			
2	3	80				12	3	40
	16	20	7	21	90		10	30
				16	10		16	30
3	6	75	8	7 & 8	85			
	13	25		16 & 21	15	13	7	60
							19	40
4	16	75	9	5	75			
	3	25		16	25	14	10	45
							4	25
5	10	85	10	14	60		16	15
	16	15		12	30		21	15
				16	10			
						15	6	70
							16	20
							13	10

Soil Management Group 1

This management group is comprised primarily (80 percent) of soils in Soil Resource Group 1. About 20 percent of the area is in SRG 16.

This group is characterized by moderately deep and deep, moderately well and well drained, medium textured soils. The relief is dominantly nearly level, outwash plains and stream terraces. The soils have moderate permeability and moderate to high available water capacity. Approximately 70 percent of the area consists of Class I and II land. These soils, under good management, are suited to continuous row cropping. Nearly all of this land is being used for agricultural production.

Included in this group are soils on more sloping relief with thinner solums and somewhat poorly drained soils in depressional areas.

About 10 percent of the area is made up of the thinner soils on more sloping relief. These soils are characterized by Class IIIe and IVe land. Under good management a five-year rotation consisting of a row crop, grain crop and three years of meadow is satisfactory. Approximately 50 percent of the Class IIIe and IVe land is used for livestock pasture.

The remaining 20 percent of this area is characterized by somewhat poorly drained soils in Class IIw land. Under good management these areas can be used for continuous row cropping.

Soil Management Group 2

This management group is comprised dominantly (80 percent) of soils in Soil Resource Group 3. About 20 percent is in SRG 16.

This group is characterized by moderately deep and deep, moderately well and well drained, medium textured soils. The relief is dominantly gently undulating glacial till plains. The soils have moderate permeability and moderate to high available water capacity. Approximately 70 percent of the area consists of Class IIe land. Under good management these soils are suited to a four-year rotation with a row crop, grain crop, and two years of meadow. Nearly 95 percent of this land is in crop production.

Included in this group are soils on more sloping relief with thinner solums and more poorly drained soils in the depressional areas.

About 10 percent of the area is comprised of thinner soils on more sloping relief. These areas are characterized by Class IIIe and IVe land. Under good management a five-year rotation consisting of a row crop, grain crop and three years of meadow is satisfactory. Over 50 percent of these more sloping areas are used for livestock pasture or are in woodlands.

About 20 percent of these areas are comprised of somewhat poorly and poorly drained soils in Class IIw land. When drained, these areas can be used for

continuous row cropping but a three-year rotation of corn, grain and hay is common. About 50 percent of these wetter areas are in pasture or woodlands.

Soil Management Group 3

Seventy five percent of this management group is comprised of soils similar to those included in Soil Resource Group 6. About 25 percent is in SRG 13.

This group is comprised of moderately deep, moderately well and well drained, medium textured soils. The relief is sloping, with 2 to 12 percent slopes predominating. These soils have moderate permeability and a moderate available water capacity. Approximately 60 percent of the area is characterized by Class IIe and IIIe land. Under good soil management these soils are suited to a five-year rotation with a row crop, grain crop and three years of meadow. Nearly all of this land is in crop production.

Included in this group are thinner soils on more sloping relief and soils on steep slopes.

About 15 percent of these areas is characterized by Class IVe land. These areas are suited to a six-year rotation consisting of row crop, grain crop, and four years of meadow. With conservation practices a five-year rotation with two years of row crops is suitable. Approximately 50 percent of these areas are in pasture or woodlots. About 25 percent of the area in this group consists of soils on steep slopes. Almost all of these soils in Class VIe and VIIe land have been maintained in pasture or woodlots.

Soil Management Group 4

This management group is comprised of soils in Soil Resource Group 16 (75 percent). About 25 percent is in SRG 3.

This group is characterized by moderately deep and deep, somewhat poorly and poorly drained soils. These soils have moderate permeability and a high available water capacity. About 75 percent of these areas consist of Class IIw and IIIw land. When drained, these areas are suited for continuous row crops but a three-year rotation of row crop, small grain and forage is more common. Approximately 25 percent of this land has been retained in pasture and woodlots.

The remaining 25 percent of this group consists of better drained soils characterized by Class IIe and IIIe land. A four-year rotation with row crop, small grain and two years of meadow is common. About 80 percent of this land is in crop production and the remainder is in pasture and woodlots.

Soil Management Group 5

This management group is comprised primarily of soils in Soil Resource Groups 10 and 16. About 85 percent falls in SRG 10 and 15 percent in SRG 16.

This group is characterized by moderately deep and deep, moderately well and well drained soils on undulating (2 to 12 percent slopes) glacial uplands. These soils have moderate permeability and moderate available water capacity. Nearly 70 percent is dominantly Class IIe and IIIe land which is suited to a five-year rotation consisting of a row crop, small grain, and three years of forage. About 20 percent of this land has been retained in pasture or woodlots.

Included in this group are thinner soils on steeper relief and more poorly drained soils in the depressional areas.

About 15 percent of the area is characterized by Class IVe land. A six-year rotation with four years of meadow is common on these areas. Nearly 50 percent of these areas has been maintained in pasture or woodland.

Approximately 15 percent of the area is comprised of wet soils that fall in Class IIw and IIIw land. When drained, many of the soils could be used for continuous row cropping but a three-year rotation with a row crop, small grain and forage is more common. About 50 percent of these wet soils have been retained in pasture and woodlots. Corn for grain is seldom grown in this group north of Waupaca County. Nearly all of this management group in Oconto, Vilas, Oneida, Forest, Florence, and Menominee Counties and in Michigan has been retained in woodlands.

Soil Management Group 6

This management group is comprised of soils principally in Soil Resource Groups 4, 7 and 16. About 65 percent is in SRG 4, 15 percent is in SRG 7, and 20 percent is in SRG 16.

This group is characterized by shallow to moderately deep, well drained, medium textured soils on gently undulating (1 to 6 percent slopes) outwash plains. These soils have moderate permeability and have moderate to low available water capacity. About 65 percent of the area is composed of soils in Class IIs, IIe and IIIe land. A four-year rotation with a row crop, small grain and two years of meadow is typical. Nearly all of this area is in crop production.

Included in this group are sandy soils, thinner soils, and poorly drained soils in depressional areas.

Approximately 15 percent of this area is comprised of sandy and thinner soils which are generally represented by Class IVs land. Under good management, a four-year rotation with row crop, small grain and two years of meadow is typical. About 40 percent is in pasture and woodland.

About 20 percent of this area is comprised of wet soils in Class IIw and IIIw land. A representative rotation would consist of a row crop, small grain and forage crop. Approximately 40 percent of these wetter soils have been retained in pasture and woodland.

Soil Management Group 7

This management group is comprised essentially of soils in Soil Resource Group 21. The rest (10 percent)are poorly drained mineral soils in SRG 16.

This group is characterized by moderately deep and deep, poorly drained organic soils in nearly level depressions. These soils have moderately rapid permeability and a high available water capacity. About 90 percent of these areas are represented by Class IIIw land. Under good management continuous row cropping is feasible but a four-year rotation with two years of row crops, one year of small grain and one year of forage is more common. About 30 percent of this area has been retained in pasture and woodlots. Most of this land in Dodge County (Horicon Marsh) is retained in wildlife habitat.

About 10 percent of the area in this group is comprised of poorly drained mineral soils on nearly level relief. These soils are characterized by Class IIw and IIIw land. An average three-year rotation of row crop, small grain and forage is practiced on these soils. About 25 percent of these wet mineral soils have been maintained in pasture and woodlots.

Soil Management Group 8

This soil management group is comprised primarily (85 percent) of soils in Soil Resource Groups 7 and 8. The poorly drained mineral and organic soils (15 percent) are in SRG's 16 and 21.

This group is composed of deep, excessively drained sandy soils on nearly level to sloping relief. These soils have rapid permeability and low available water capacity. About 70 percent of these areas are characterized by being in Class IIIe, IIIs, and IVs land. A four-year rotation consisting of row crop, small grain and two years of hay is typical. Corn for grain is not grown north of Green Bay. Approximately 40 percent of this group occurring south of Green Bay and 90 percent north of Green Bay is in pasture or woodlots. Under irrigation, high value crops such as potatoes can be grown one year out of three on the nearly level areas.

Included in this area are poorly drained soils and soils on steeper slopes.

About 15 percent of the total area is comprised of soils on slopes of over 6 percent. These areas are generally not well suited for growing row crops and are generally maintained in pasture or woodlots.

Approximately 15 percent of this group is comprised of wet mineral and organic soils which fall into Class IIIw land. A four-year rotation of row crop, small grain and two years of hay is typical. Corn for grain is not grown north of Green Bay. Approximately 50 percent of these wet soils south of Green Bay and 90 percent north of Green Bay is in pasture or woodlots.

Soil Management Group 9

This soil management group is comprised dominantly of soils in Soil Resource Group 5. The other 25 percent is in SRG 16.

This group is composed of deep, moderately well to well drained, fine textured soils on gently undulating (1 to 6 percent slopes) till plains. These soils have a moderately slow permeability and a high available water capacity. About 75 percent of this group is characterized by Class IIs and IIe, and IIIe land. A typical crop rotation is row crop, grain crop, and two years of alfalfa-brome. About 10 percent of these areas have been retained in pasture and woodlots.

Included in this group and making up about 25 percent of the total area are more poorly drained soils. These soils are characterized by Class IIw and IIIw land. A four-year rotation is generally practiced. About 40 percent of these wetter soils have been retained in pasture and woodland.

Soil Management Group 10

This soil management group is characterized by similar soils as are found in Soil Resource Groups 12, 14, and 16. About 30 percent of the area is in SRG 12; 60 percent is in SRG 14; and 10 percent is in SRG 16.

Included in this group are moderately deep and thin, somewhat excessively drained loamy and gravelly soils on rolling relief (6 to 20 percent slopes). These soils have moderate to rapid permeability and moderate to low available water capacity. About 60 percent of the total area may be characterized by Class IIIe and IVe land. A five-year rotation with row crop, small grain and three years of hay is typical. About 60 percent of these soils are being used for recreation, pasture or woodlands.

Approximately 40 percent of the land area in this group is comprised of wet soils in depressional areas and thin soils on steep relief. These areas are being used almost entirely for recreation, pasture and woodlots.

Soil Management Group 11

This soil management group has similar soils as those found in Soil Resource Groups 2 and 20. About 80 percent is in SRG 2 and 20 percent is in SRG 20.

This group is characterized by having deep, moderately well to poorly drained, loamy soils on nearly level (0 to 2 percent slopes) stream flood plains. These soils have moderate permeability and a high available water capacity. This group has about 90 percent of the total area in Class IIw and IIIIw land. A typical rotation is three years of row crop and two years of meadow. About 15 percent of these Class IIw lands have been retained in pasture and woodlots.

The remaining 10 percent of the area in this group is subject to frequent overflow and is used primarily for pasture and woodlots.

Soil Management Group 12

This soil management group is comprised of soils in Soil Resource Group 3, 10 and 16. About 40 percent is in SRG 3, 30 percent is in SRG 10, and 30 percent is in SRG 16.

This group includes moderately deep and deep, well drained, loamy soils on undulating (2 to 12 percent slopes) uplands. These soils have moderate permeability and moderate to high available water capacity. These better drained soils comprise about 70 percent of the total area. Class IIe and IIIe land is typical for these soils. A suitable rotation is a row crop, small grain and three years of forage. About 20 percent of this land has been retained in pasture and woodlots.

Approximately 30 percent of the area in this group is comprised of wetter soils which are characterized by Class IIw and IIIw land. A typical rotation is two years of row crop, 1 year of small grain, and one year of forage crop. About 40 percent of these wetter soils have been maintained in pasture and woodlands.

Soil Management Group 13

This soil management group is characterized by soils in Soil Resource Groups 7 and 19. About 60 percent is in SRG 7 and 40 percent is in SRG 19.

Included in this group are deep, excessively drained to wet sandy soils on nearly level relief (0 to 3 percent slopes). Organic soils occur in the larger depressions. These soils have moderately rapid permeability and a moderate to low available water capacity. About 60 percent of the total area is characterized by Class IIIw and IVw land. A four-year rotation with row crop, small grain, and two years of forage is typical. Corn is grown for silage north of Green Bay.

Approximately 60 percent of these wetter soils have been retained in pasture and woodlots.

The other 40 percent of this group is comprised of better drained sandy soils which are characterized by Class IIe and IVe land. Rotation and yields on these soils are similar to those on the wetter soils. Approximately 50 percent of these better drained areas have been retained in pasture and woodlots.

Soil Management Group 14

This soil management group is comprised principally of soils in Soil Resource Groups 4, 10, 16 and 21. About 25 percent is in SRG 4; 45 percent is in SRG 10; 15 percent is in SRG 16 and 15 percent is in SRG 21.

This group is characterized by moderately deep and deep, moderately well and well drained, loamy soils on undulating relief (2 to 12 percent slopes). These soils have moderate permeability and moderate available water capacity. Approximately 70 percent of the area is characterized by Class IIe, IIIe and IIs land. A four-year rotation with a row crop, small grain and two years of forage is typical. Corn for grain is seldom grown north of Green Bay. About 40 percent of these areas south of Marinette County in Wisconsin has been retained in pasture and woodland. In Marinette County and to the north, over 90 percent of the area has been retained in woodland.

The other 30 percent of the area in this group is comprised of wet mineral and organic soils in depressional areas. Class IIw, IIIw and IVw land characterizes these soils. Almost all of these wet soil areas are used for pasture or have been maintained in woodlands.

Soil Management Group 15

This soil management group is comprised primarily of soils in Soil Resource Groups 6, 13, and 16. About 70 percent is in SRG 6, 10 percent is in SRG 13, and 20 percent is in SRG 16.

This group is comprised of moderately deep, moderately well to well drained loamy soils over bedrock on gently undulating relief (1 to 6 percent slopes). These soils have moderate permeability and moderate available water capacity. Approximately 70 percent of the area of this group is typified by Class IIe, IIIe, and IIIs land. A typical rotation consists of row crop, small grain and two years forage. Corn is seldom grown for grain production. About 50 percent of these soils areas have been retained in recreation, pasture, woodland and orchards.

Included in this group are thin soils on steep relief and wet soils in depressional areas.

Approximately 10 percent of the entire area is comprised of soils on steep slopes which are not suited to cultivation. Most of this area has been retained in pasture and woodlands.

The other 20 percent of the area in this group is comprised of wetter soils in Class IIw and IIIw land. A typical rotation and yields to be expected are the same as for the better drained soils in this group. Over 60 percent of these wet soil areas have been retained in pasture and woodlands.